# Ultra-high Fidelity Controller Hardware-in-the-Loop (cHIL)
# Nanosecond resolution “flight simulator” for future grid

Typhoon HIL, Inc

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- **Complexity** of the cyber-physical system is driving the need for new test tools/methods
- Real-time Controller **Hardware-in-the-loop** (cHIL) simulation is becoming ubiquitous in power electronics and power systems

# Standard picture of the power grid

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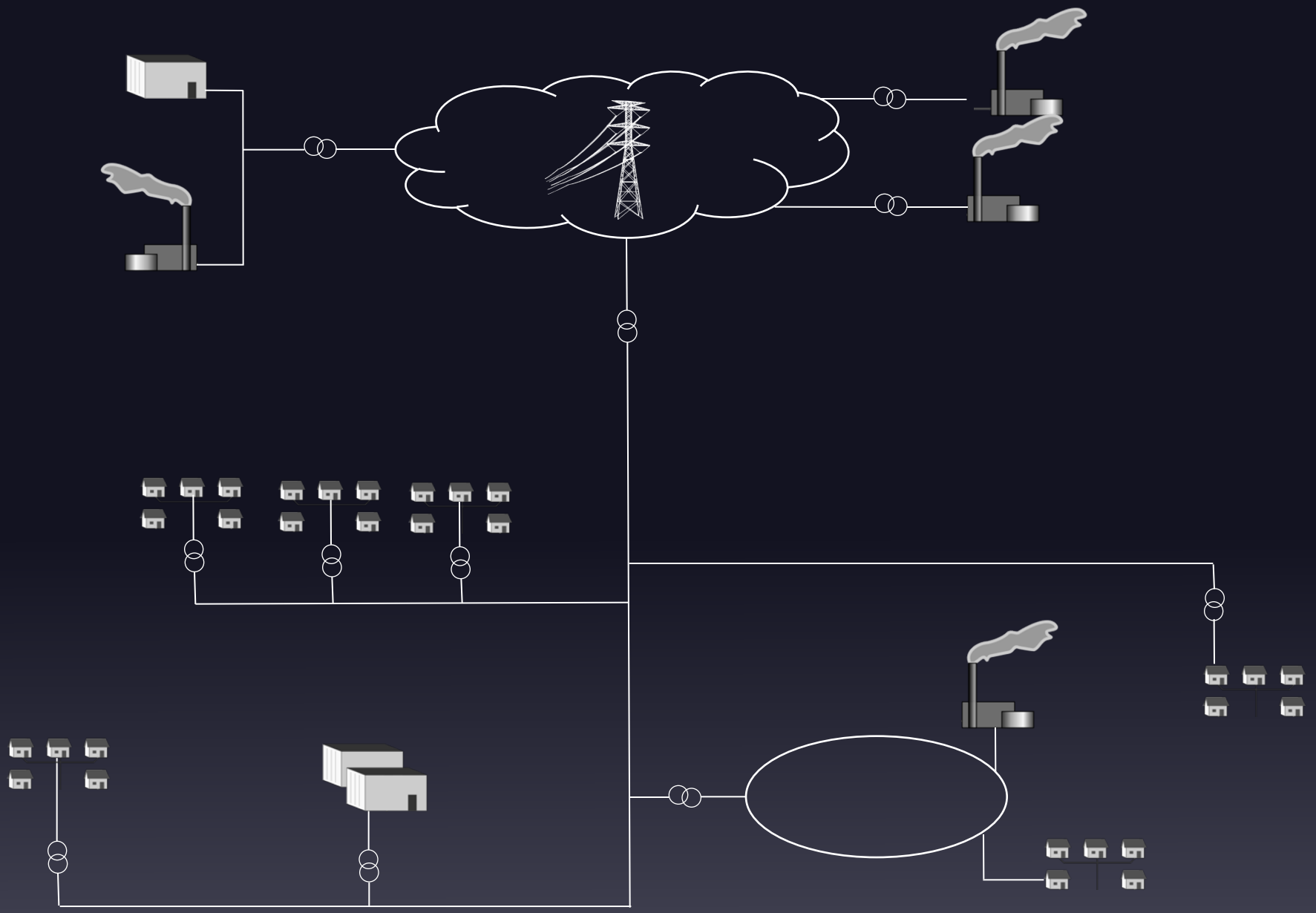

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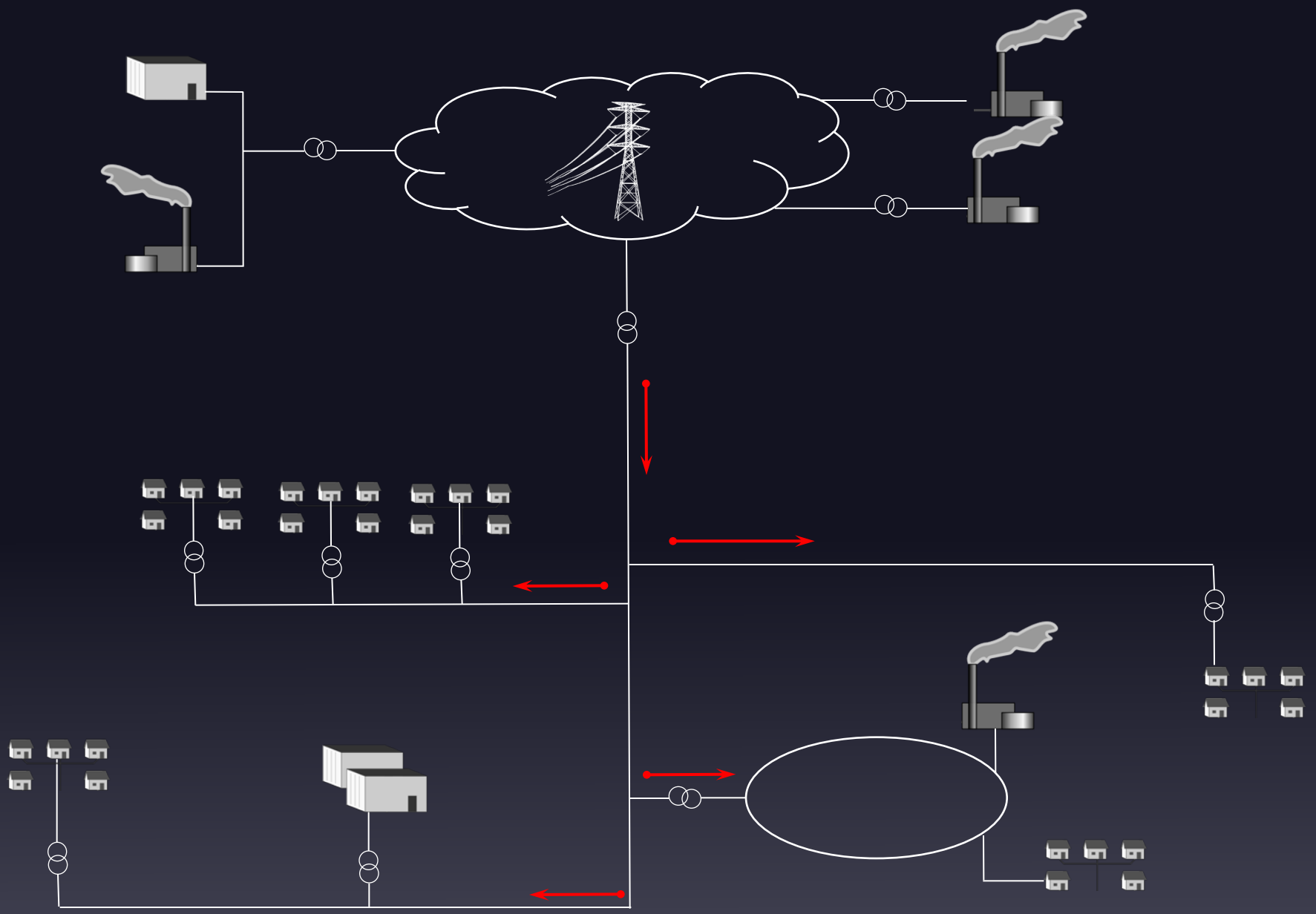
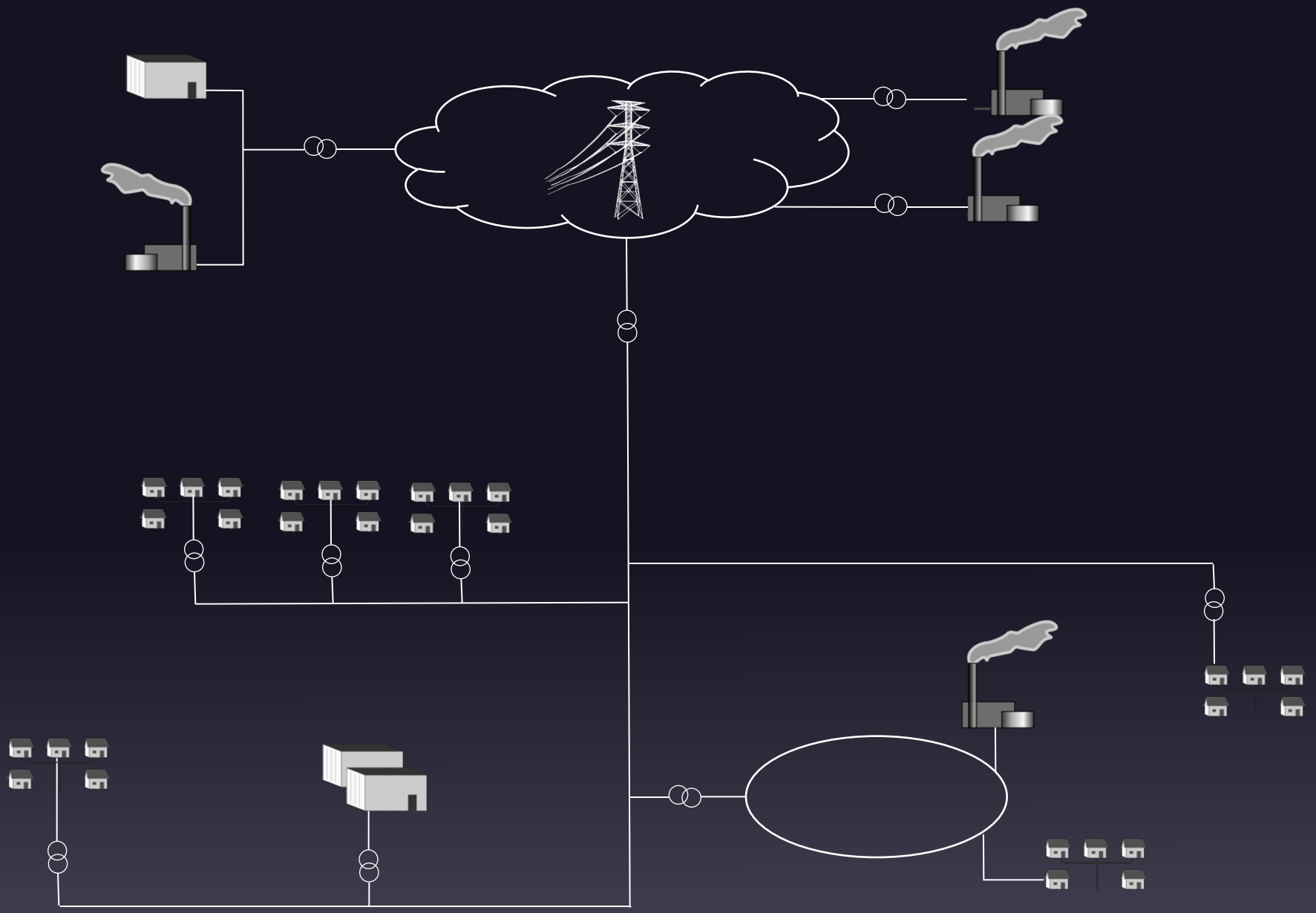


# Emerging cyber-physical power grid



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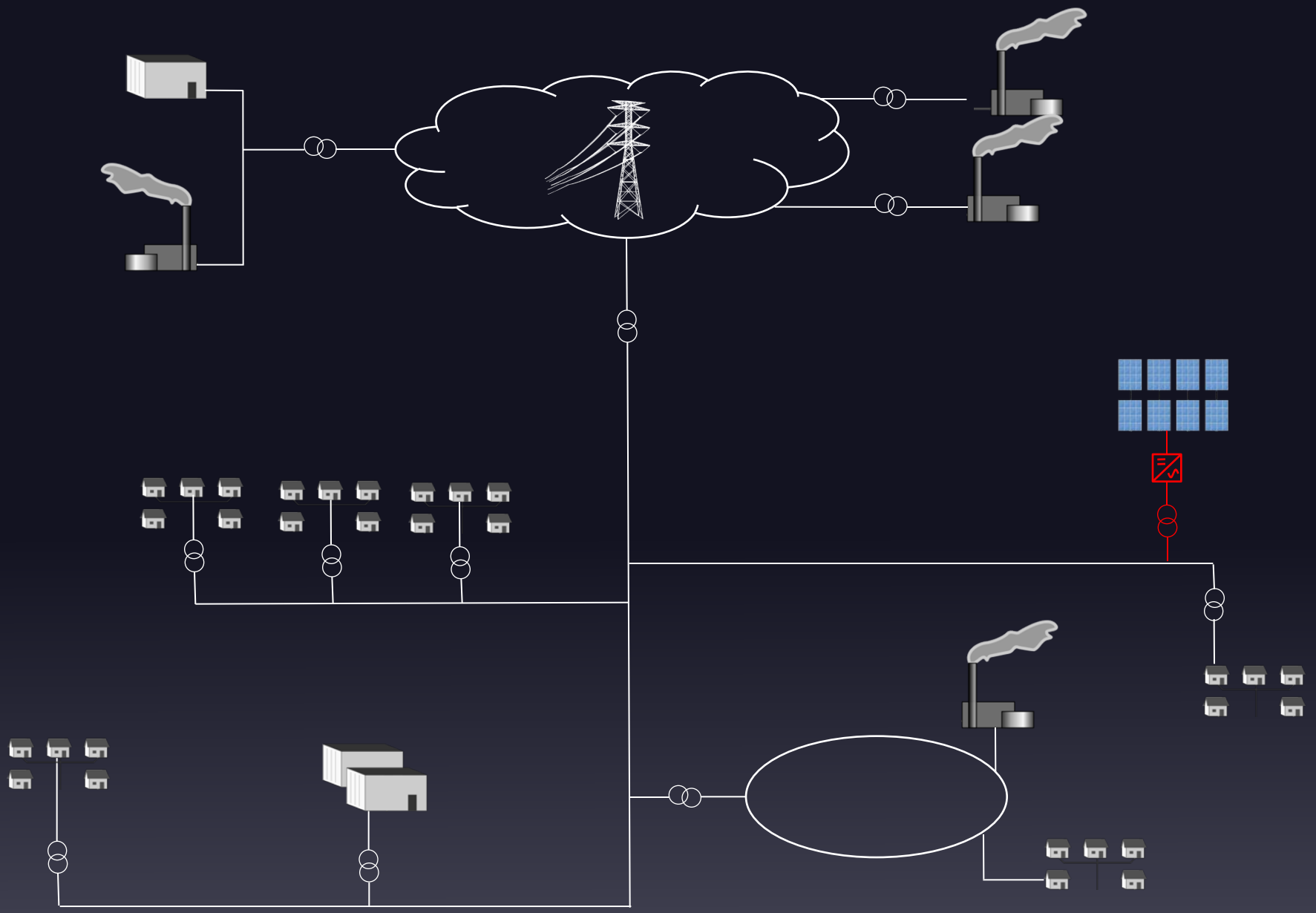

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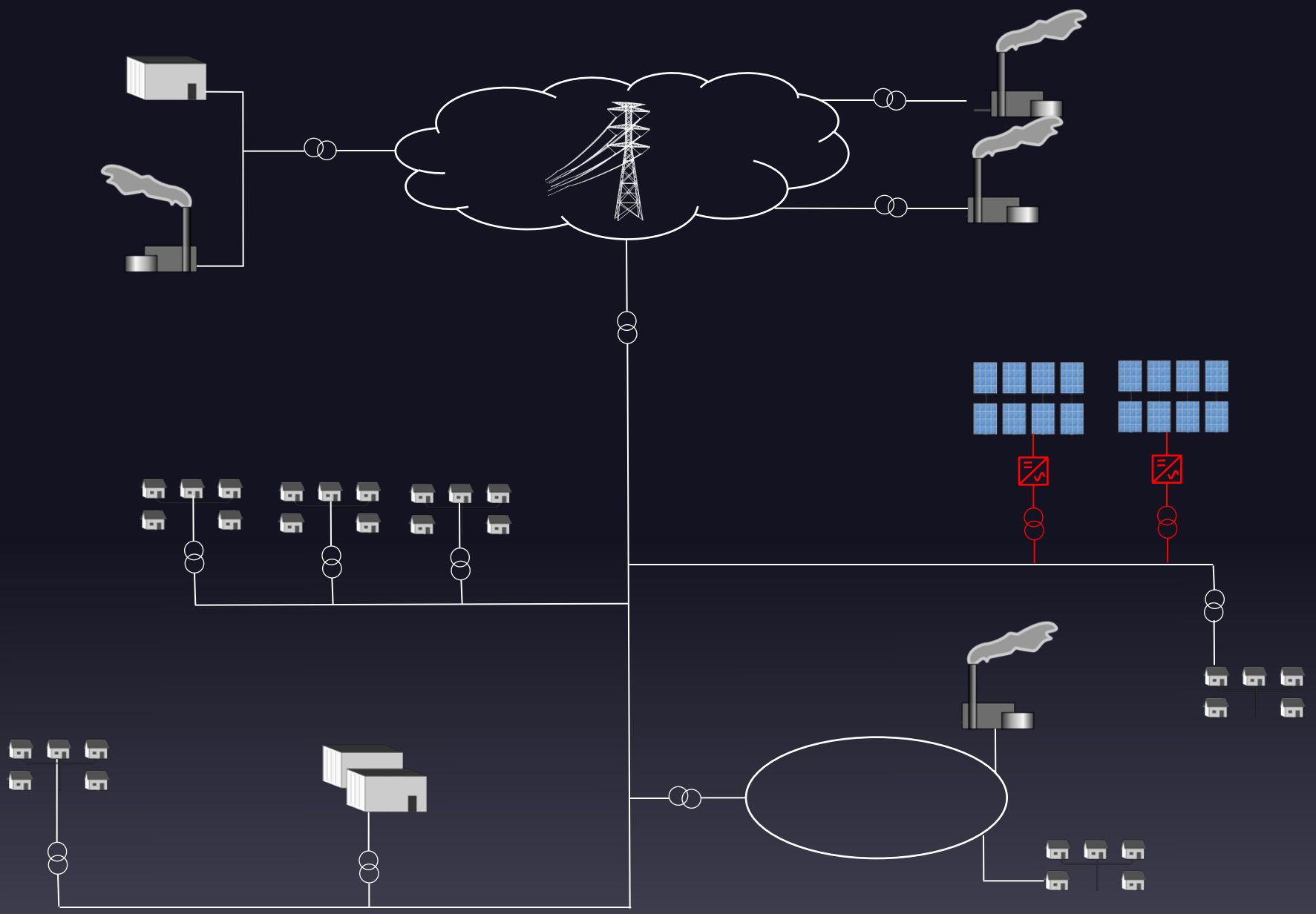

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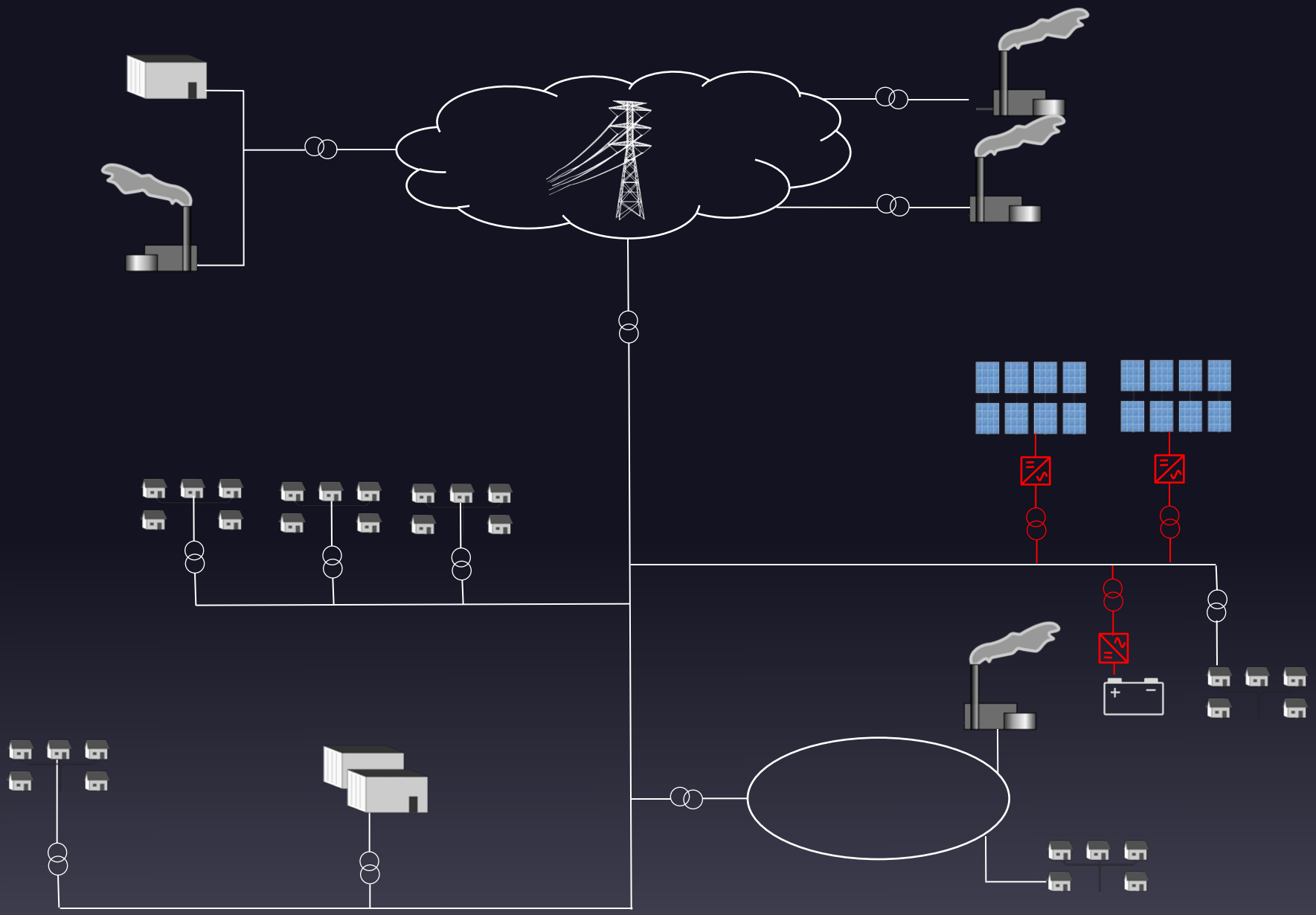

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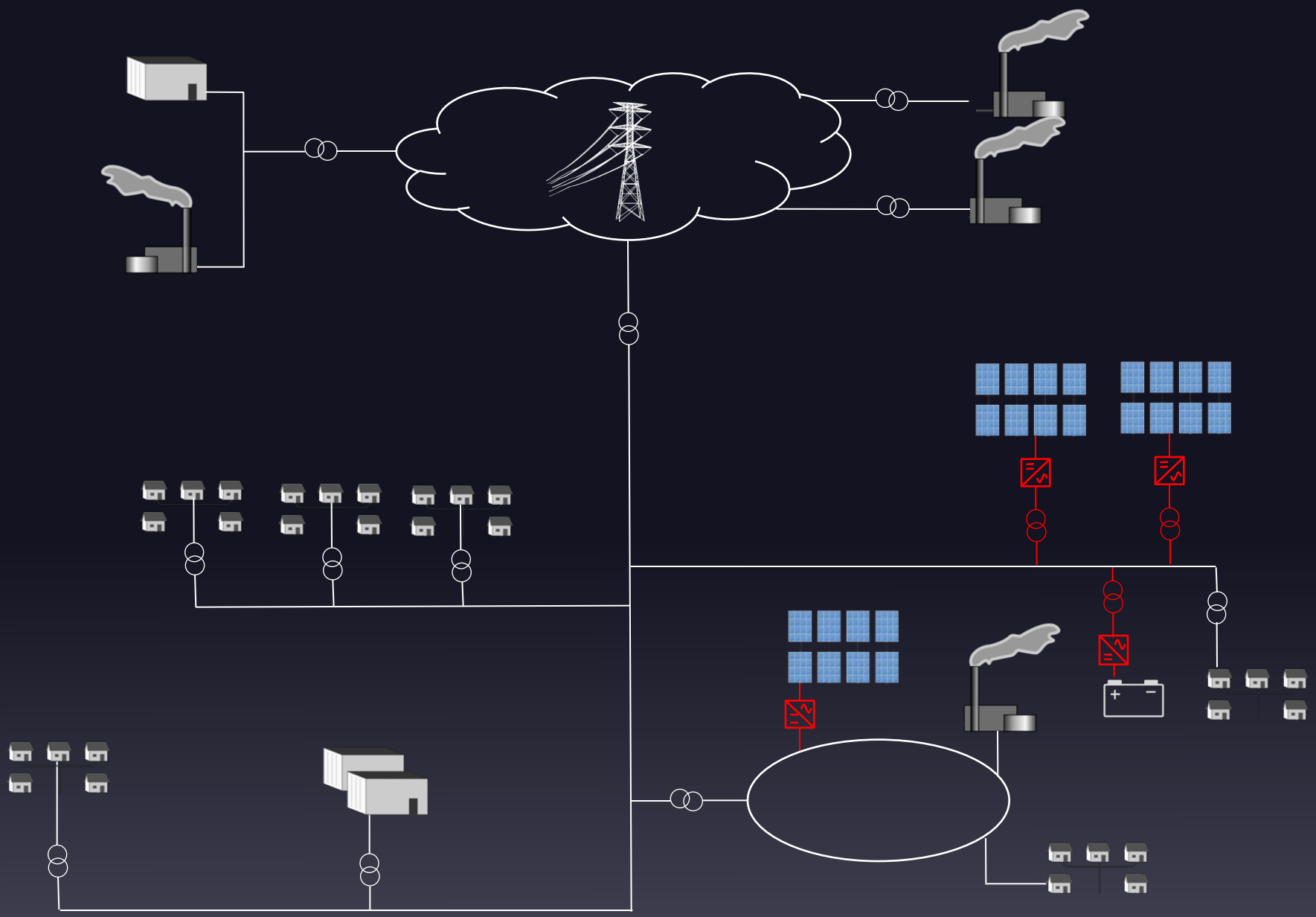

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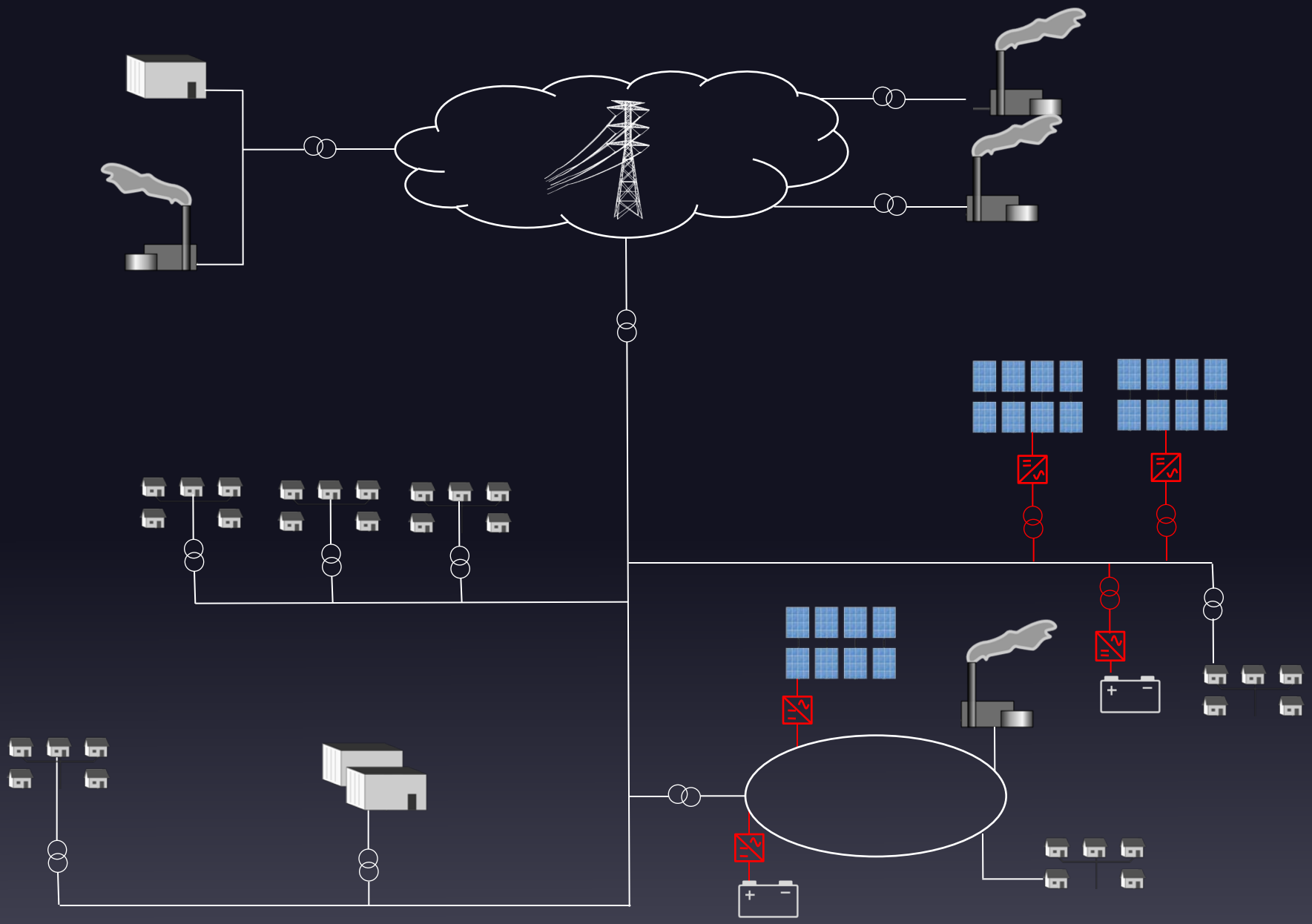

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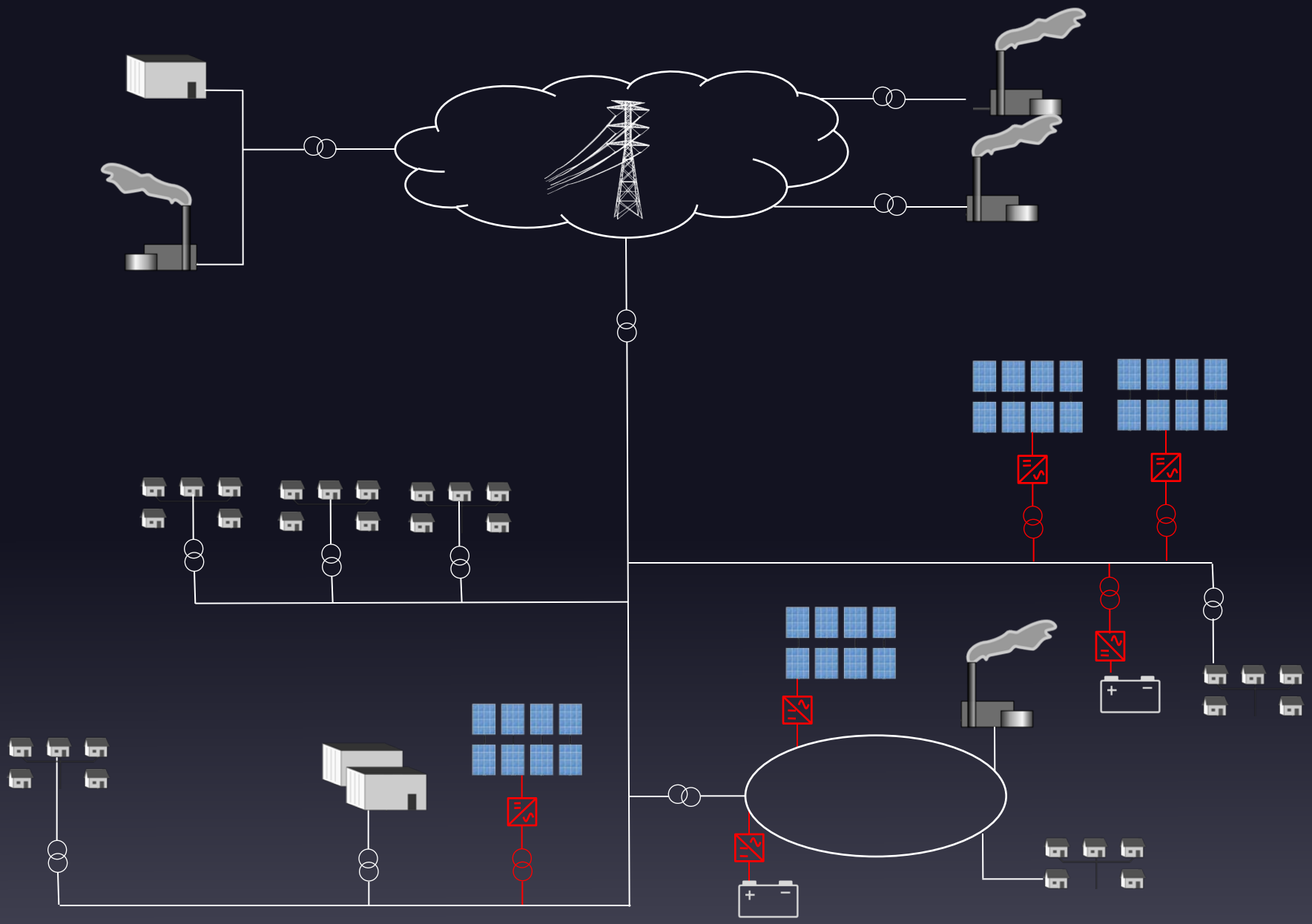

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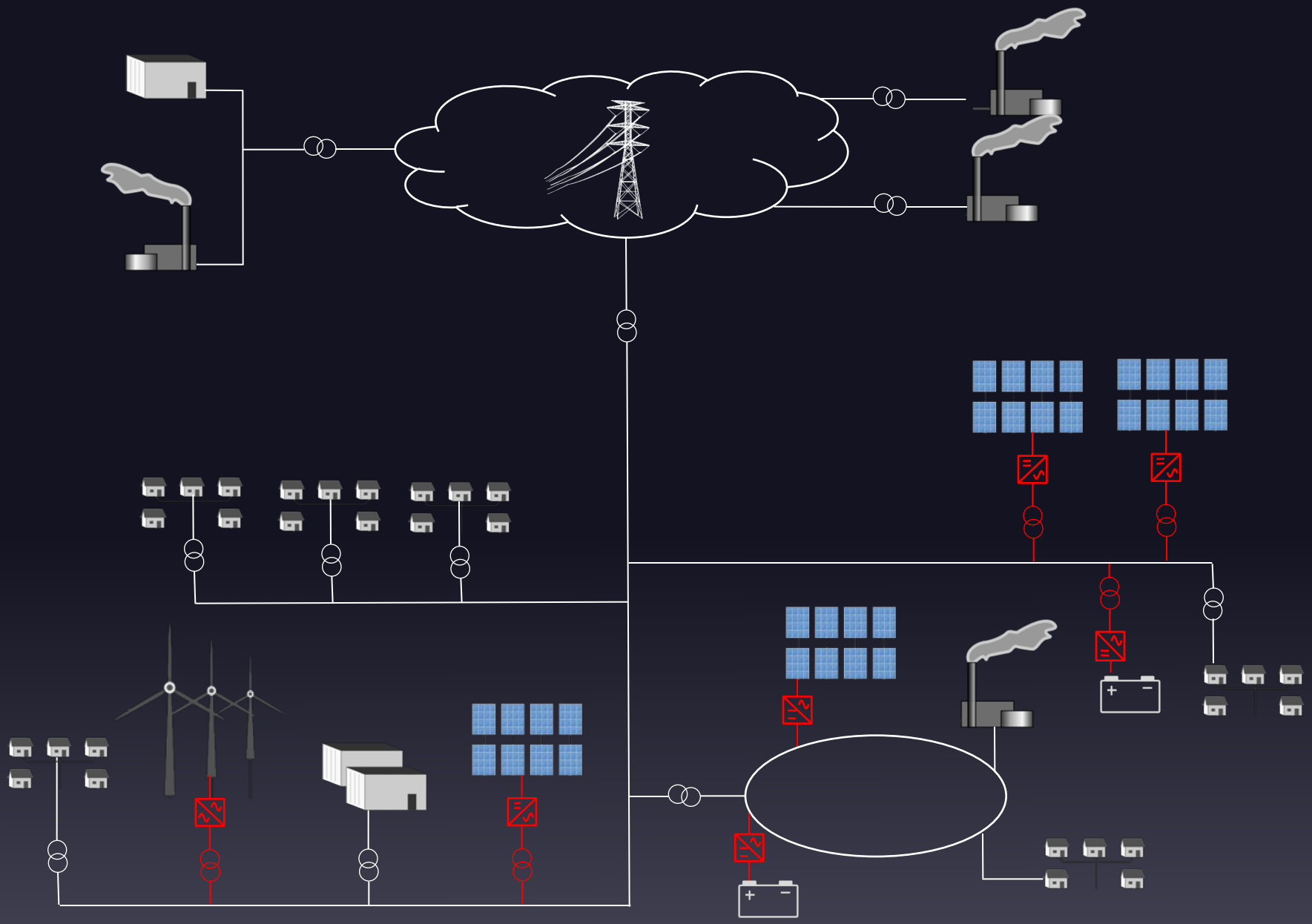

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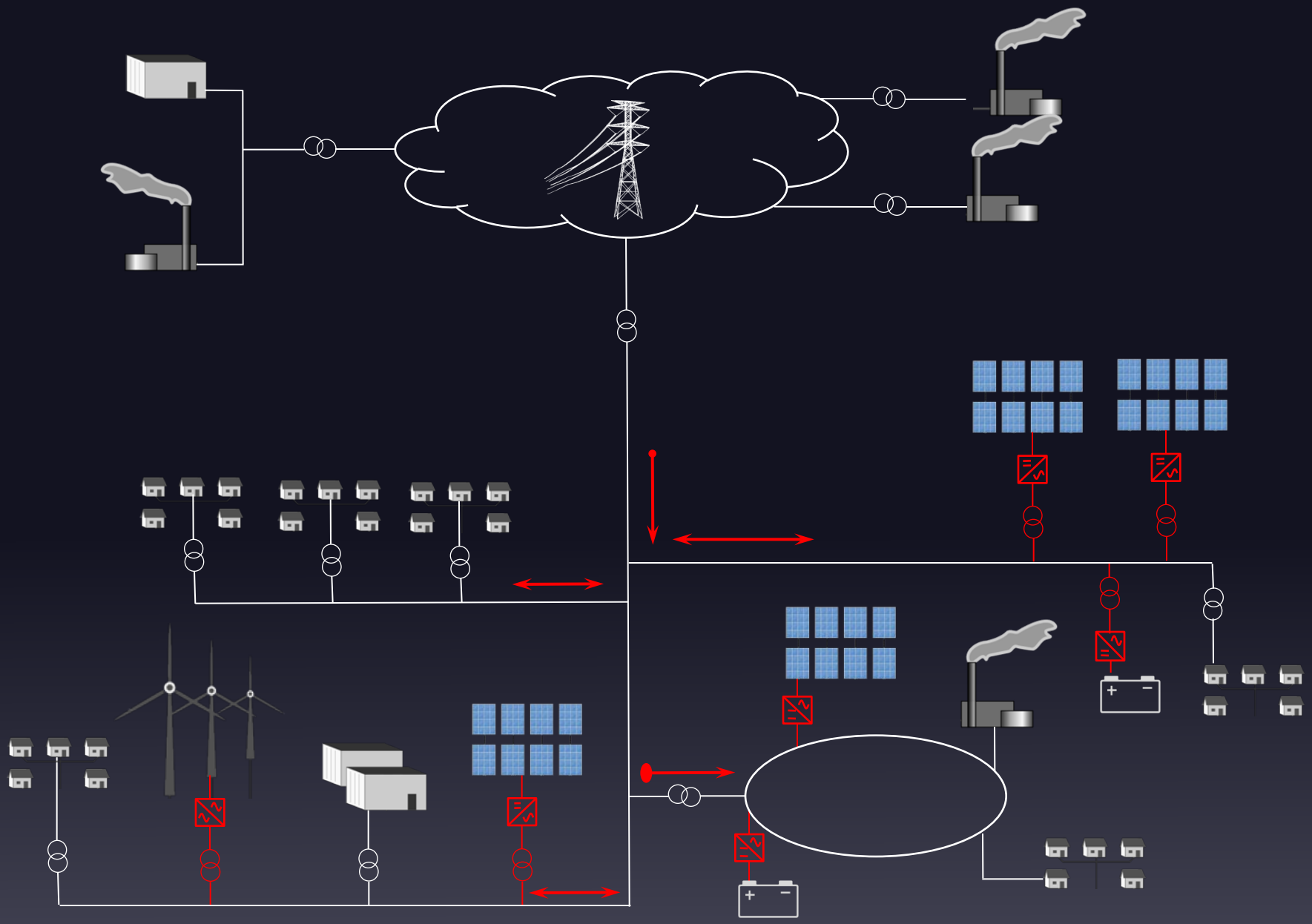

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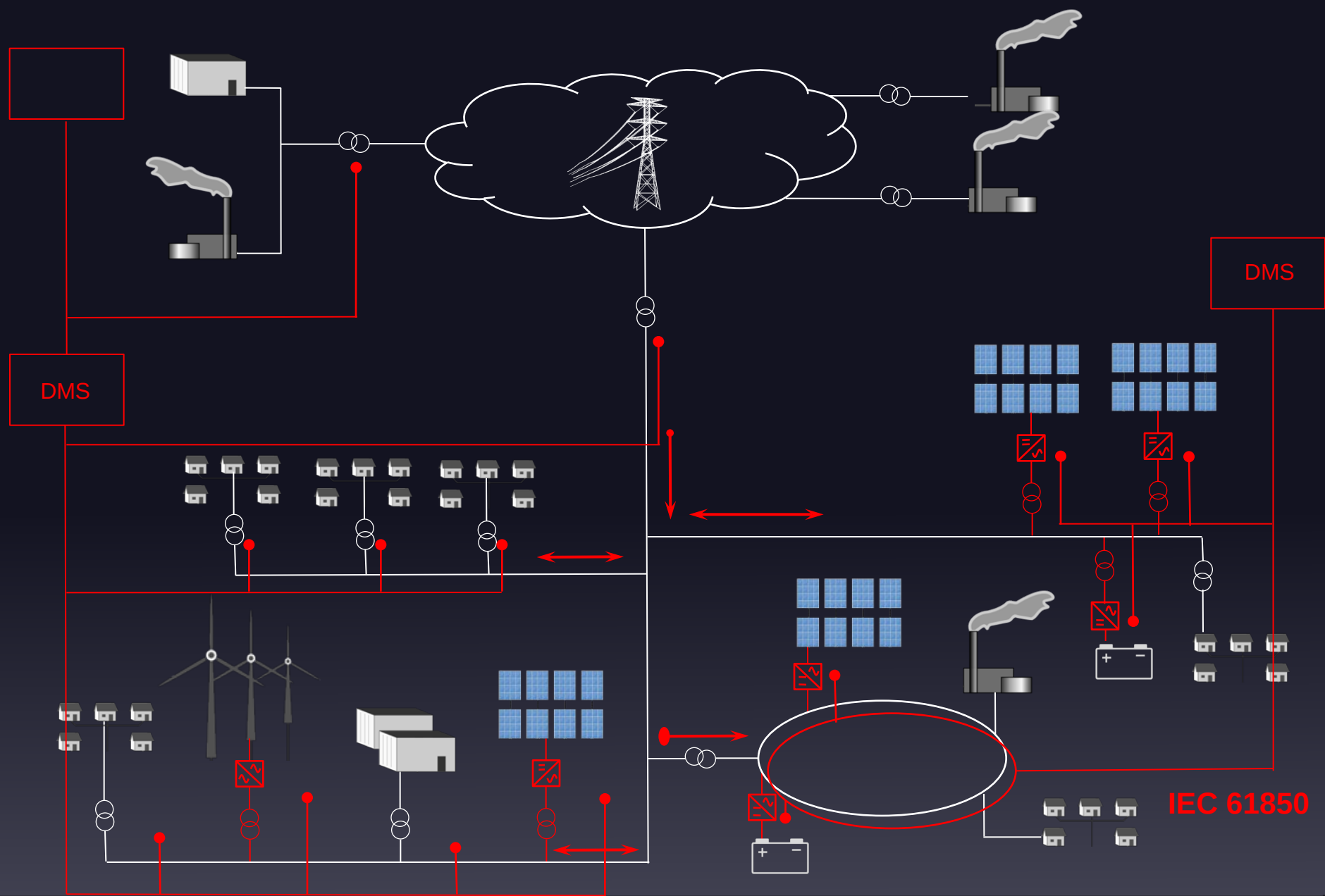

# Approaches to control and communication testing in cyber-physical systems

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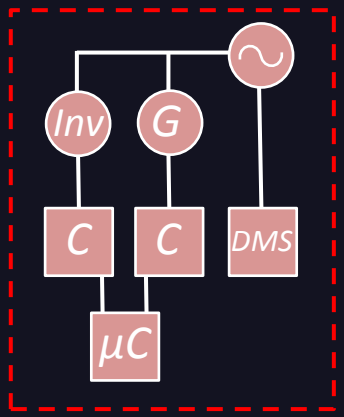
Simulation



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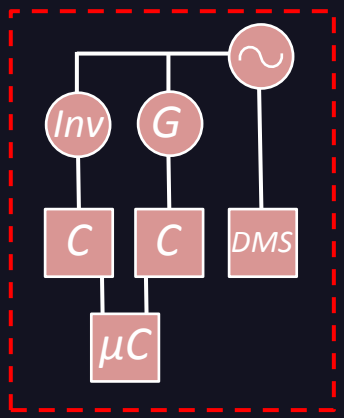
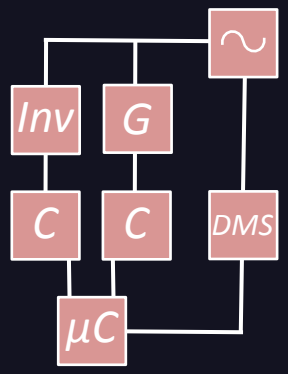



Complete System



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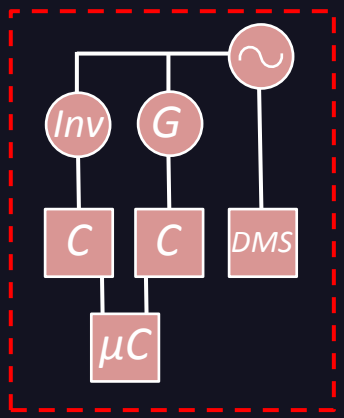
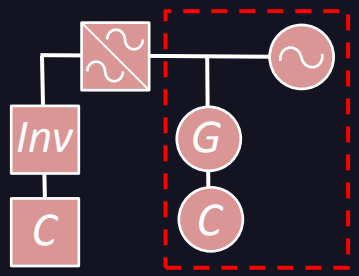



Power HIL

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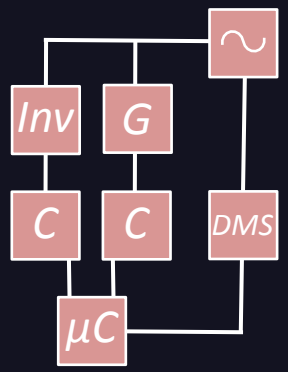

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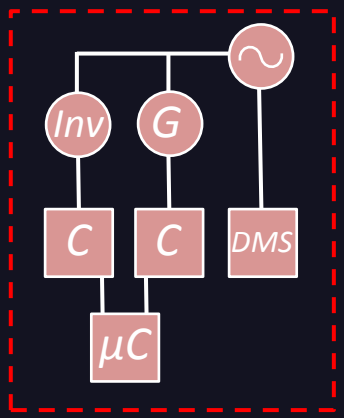


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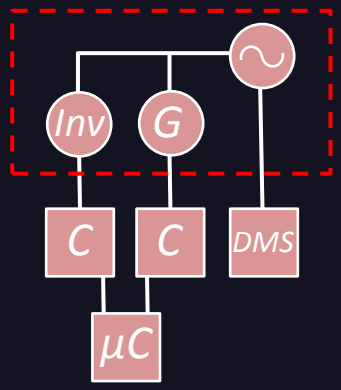


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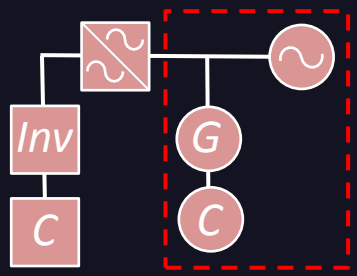


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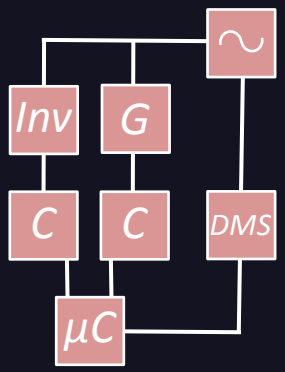

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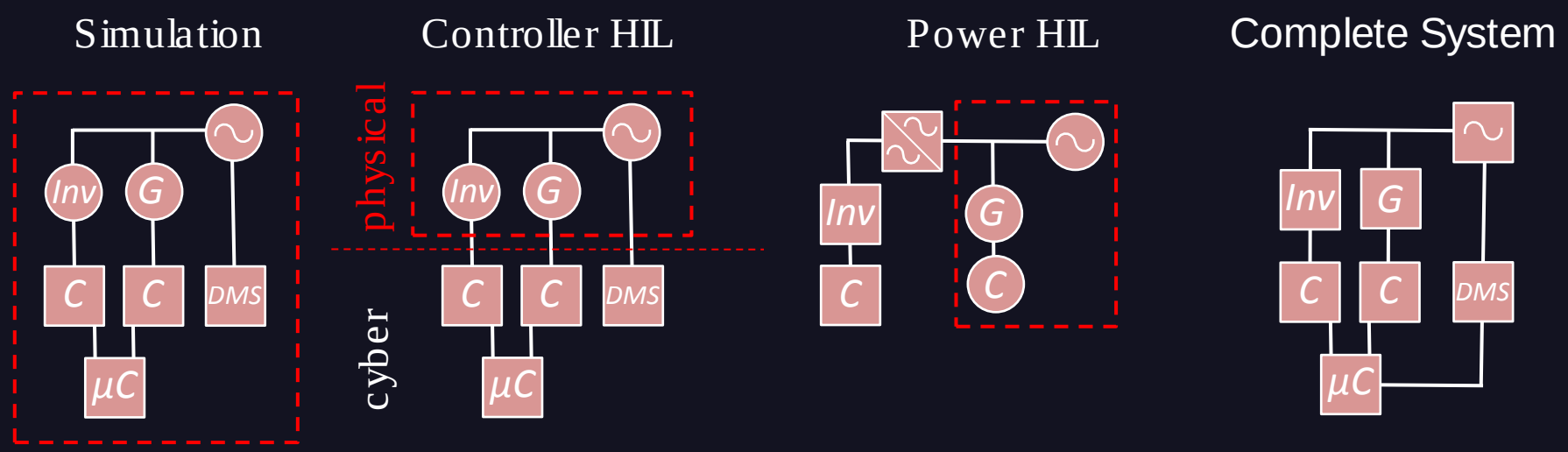

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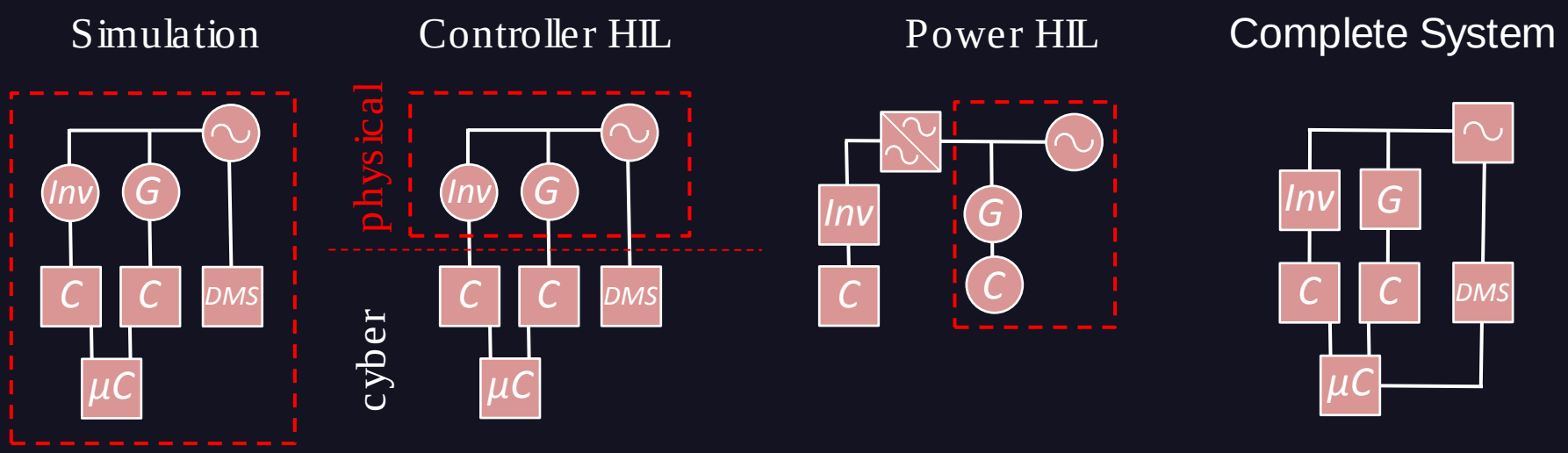


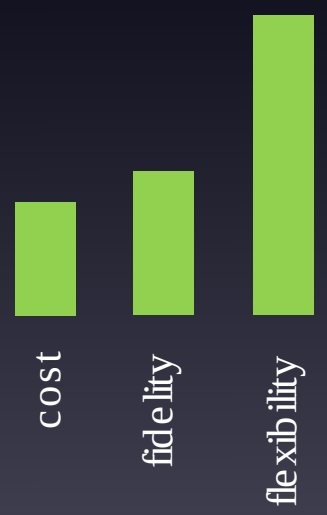

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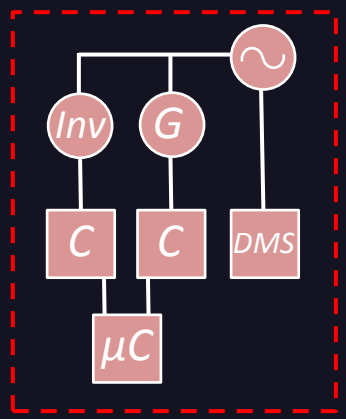
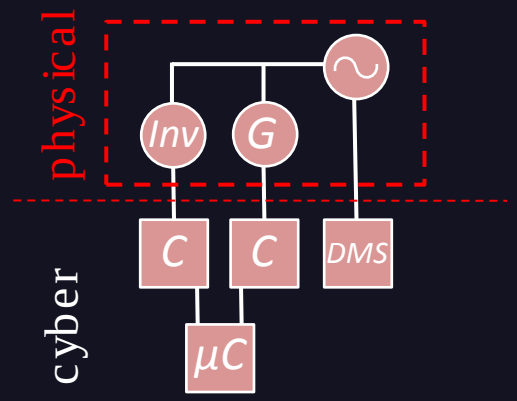



Controller HIL

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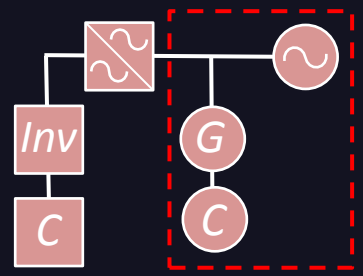


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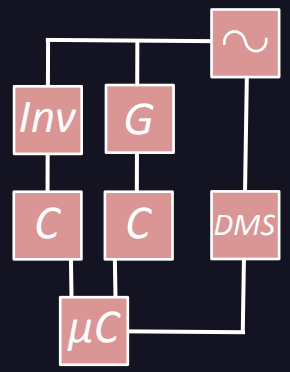


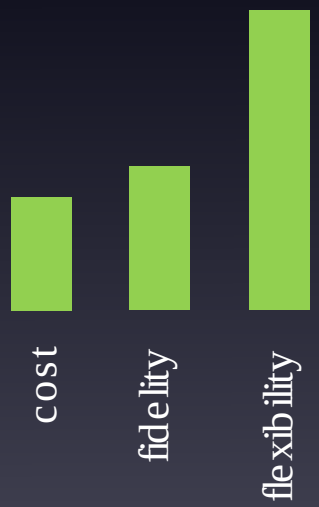


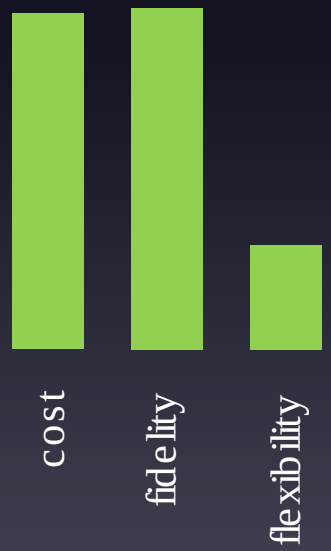

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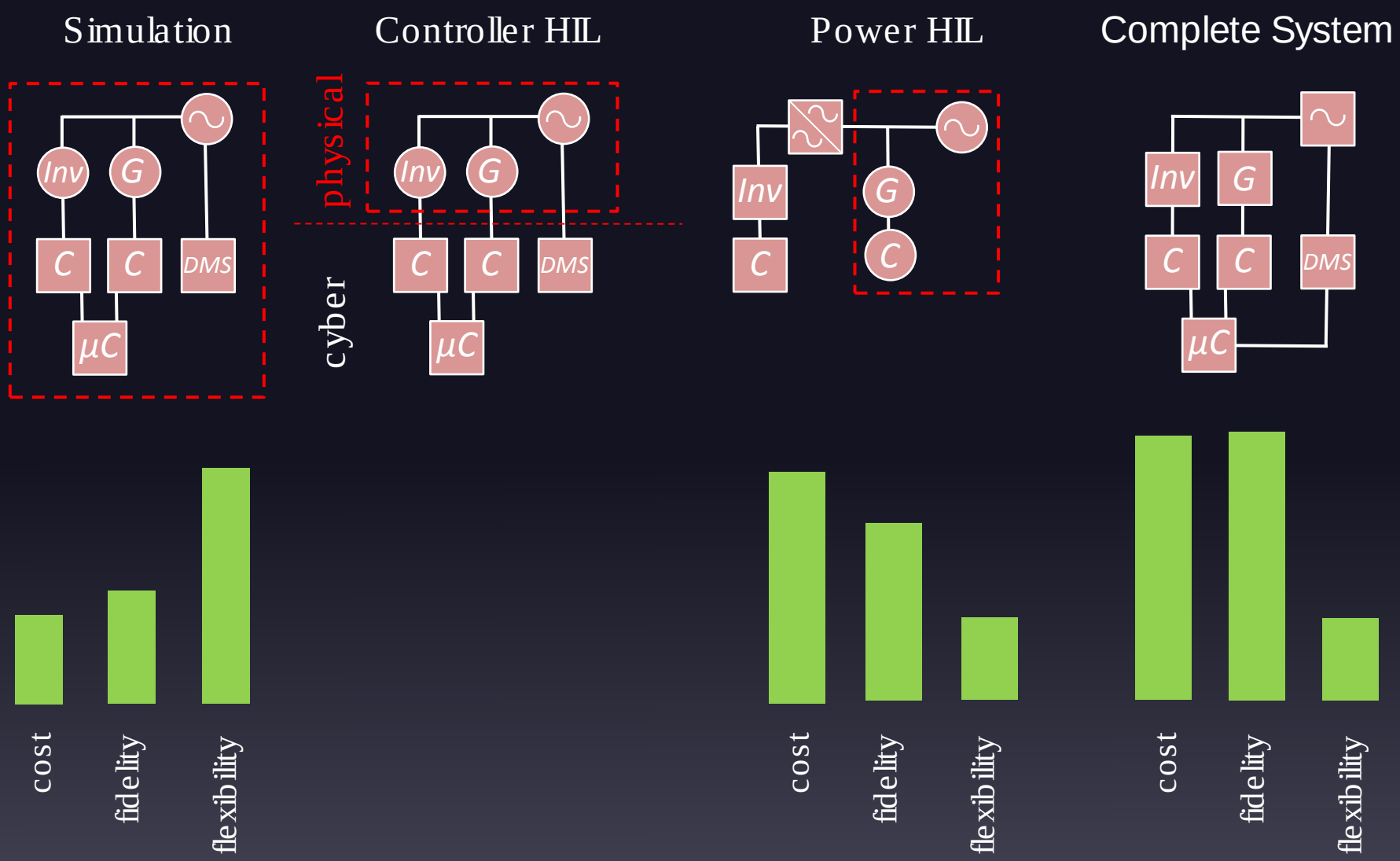

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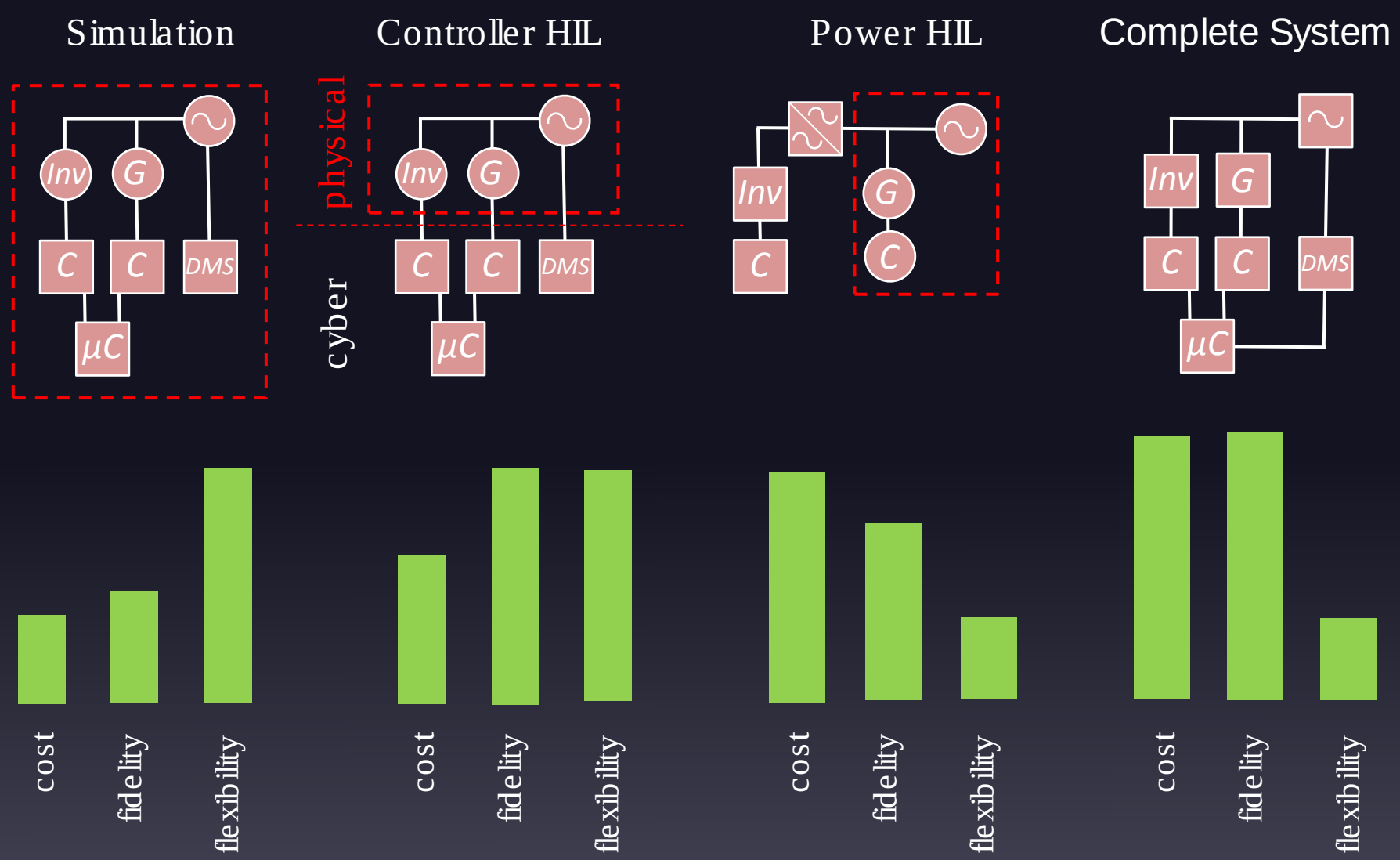

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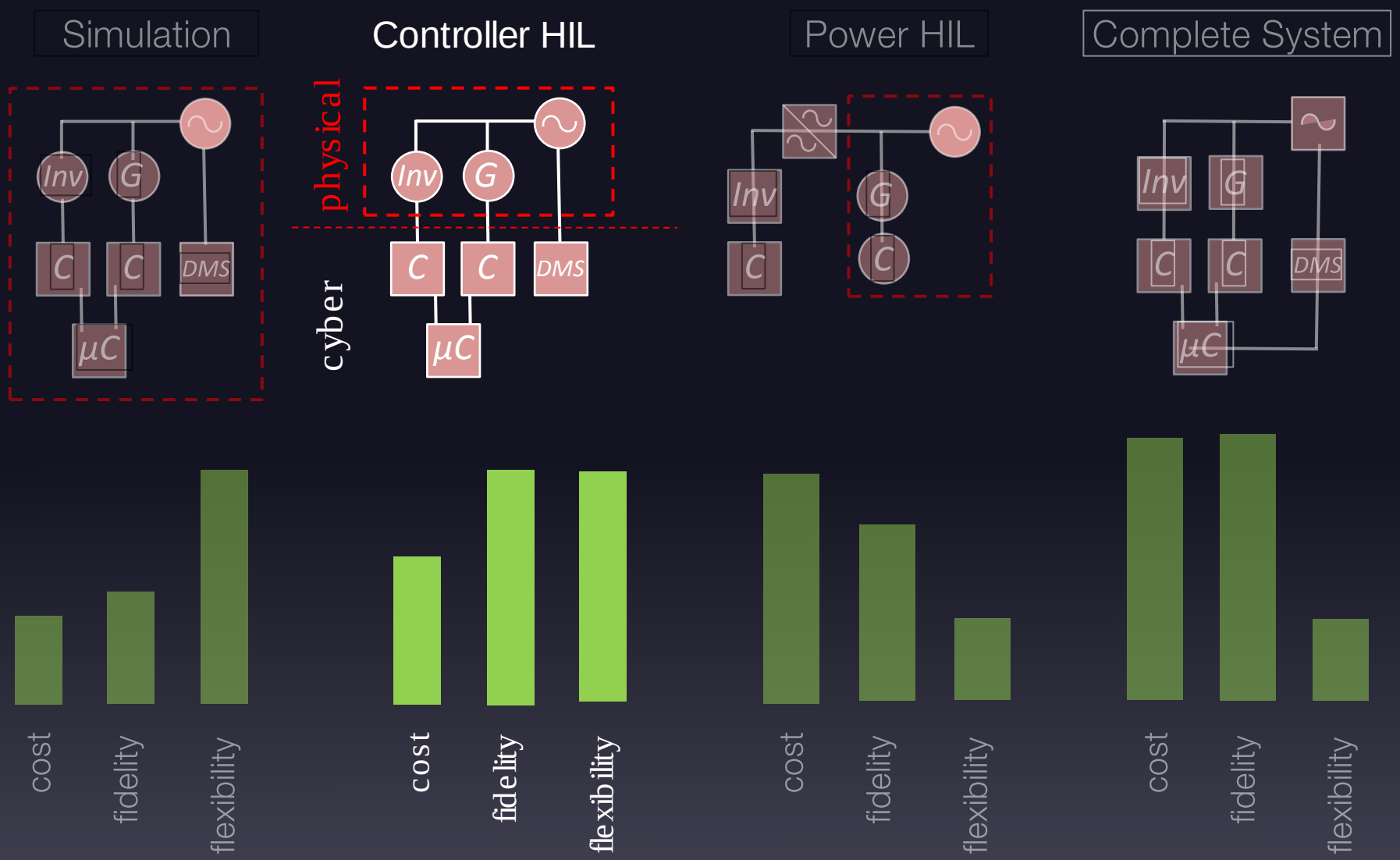

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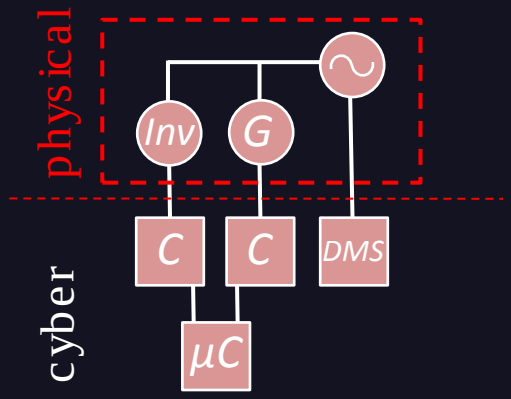
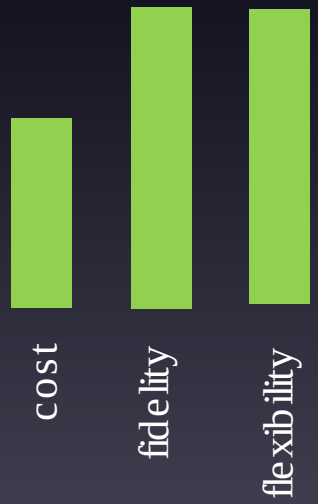
Controller HIL



The new way of **TESTING** power electronics **controllers**.
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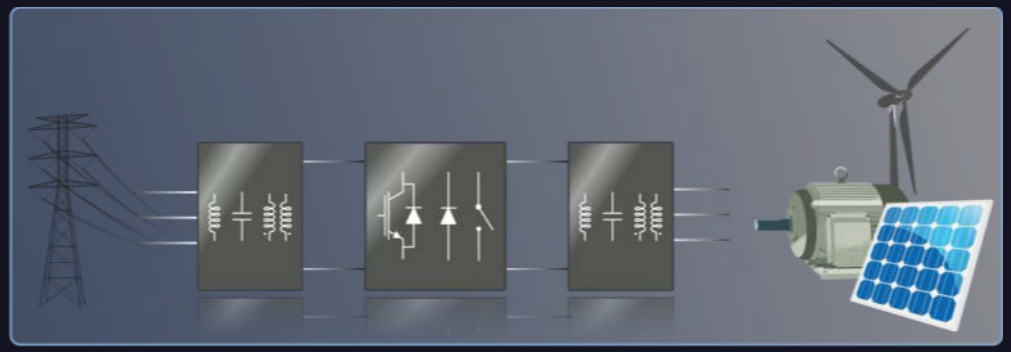

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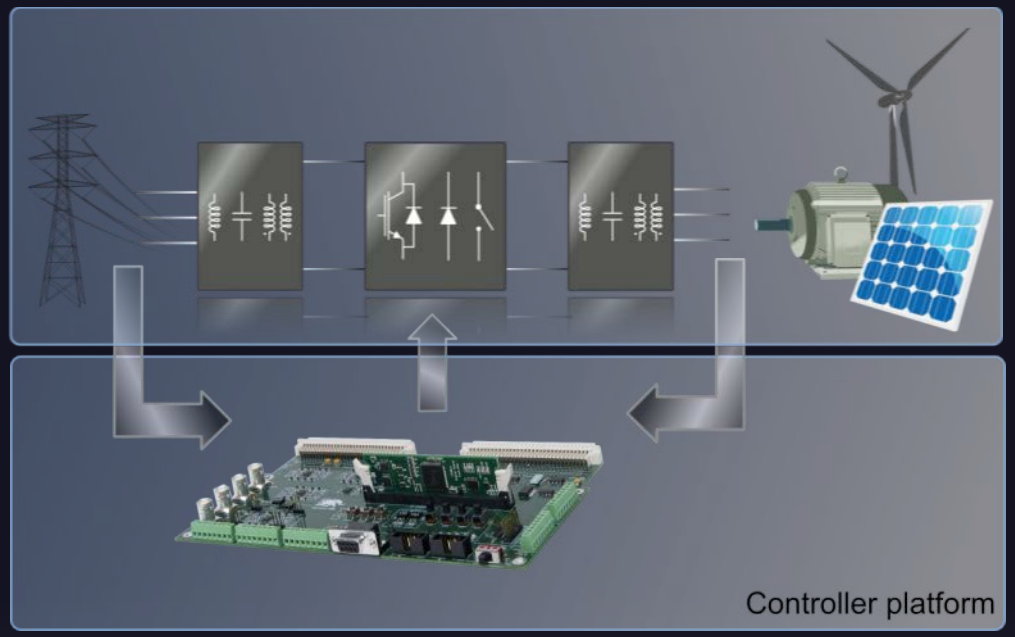

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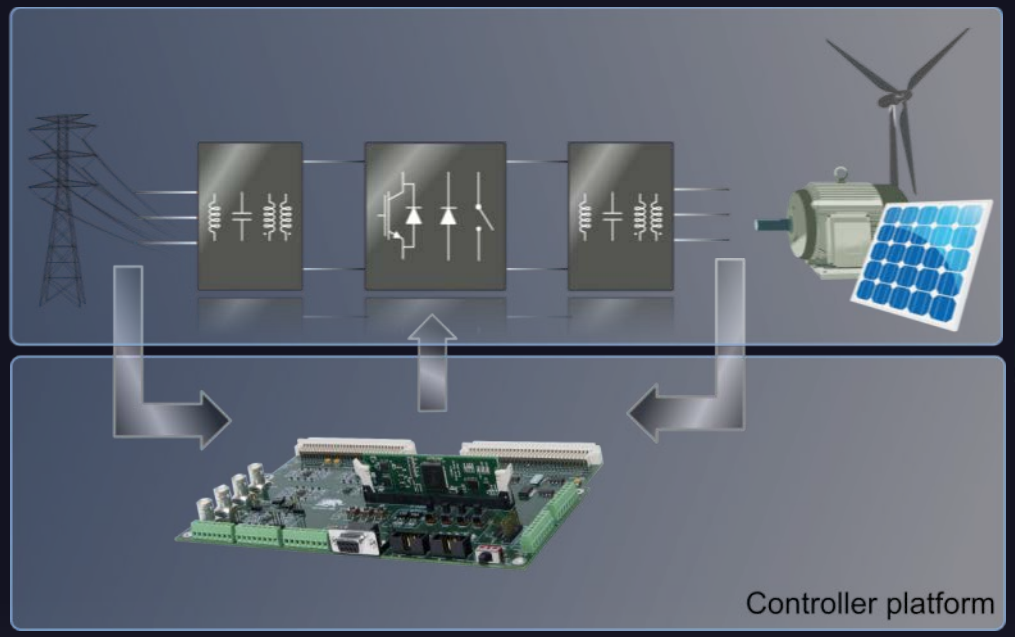


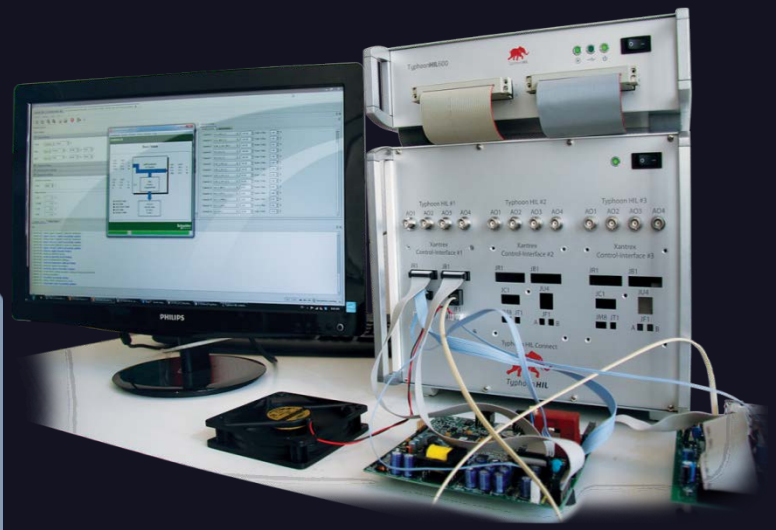

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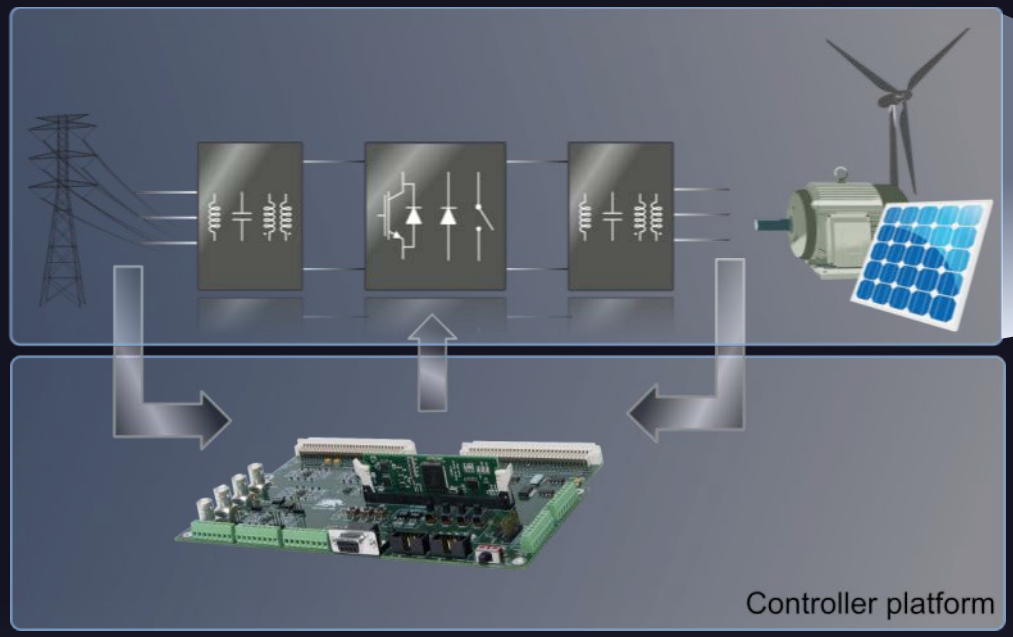


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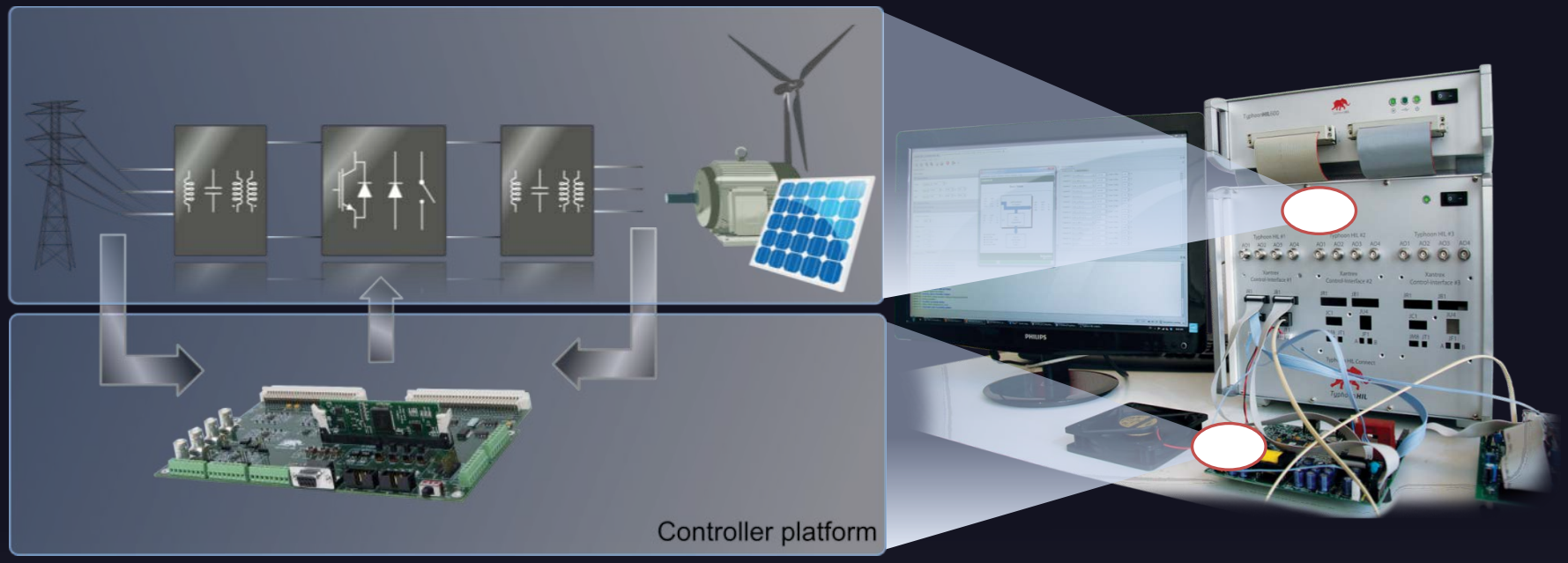

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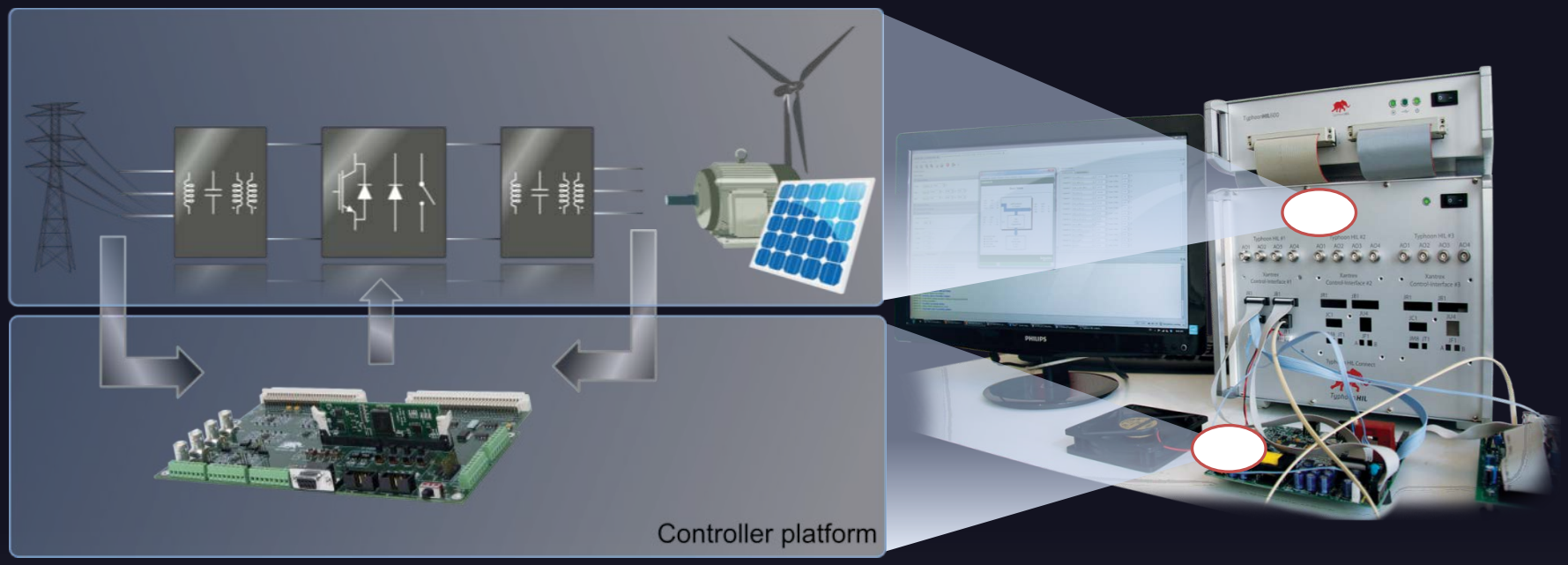


R&D

Power electronics product lifecycle

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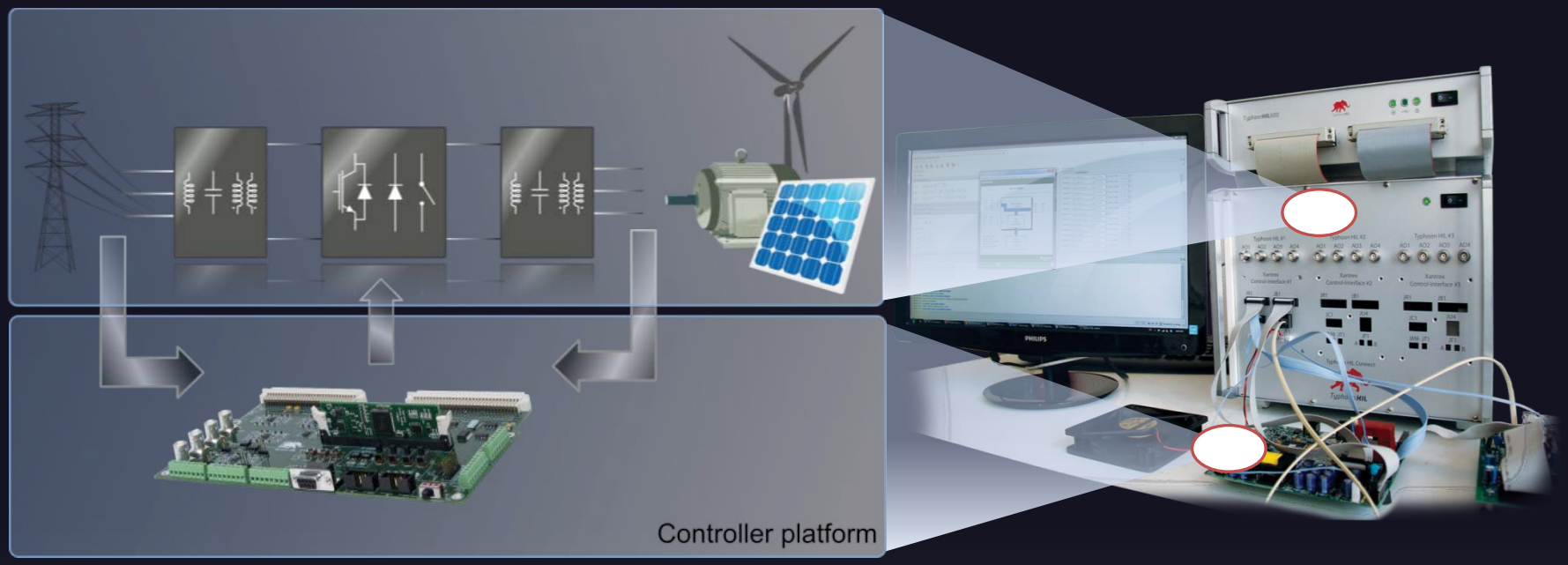


R&D | Development |

Power electronics product lifecycle

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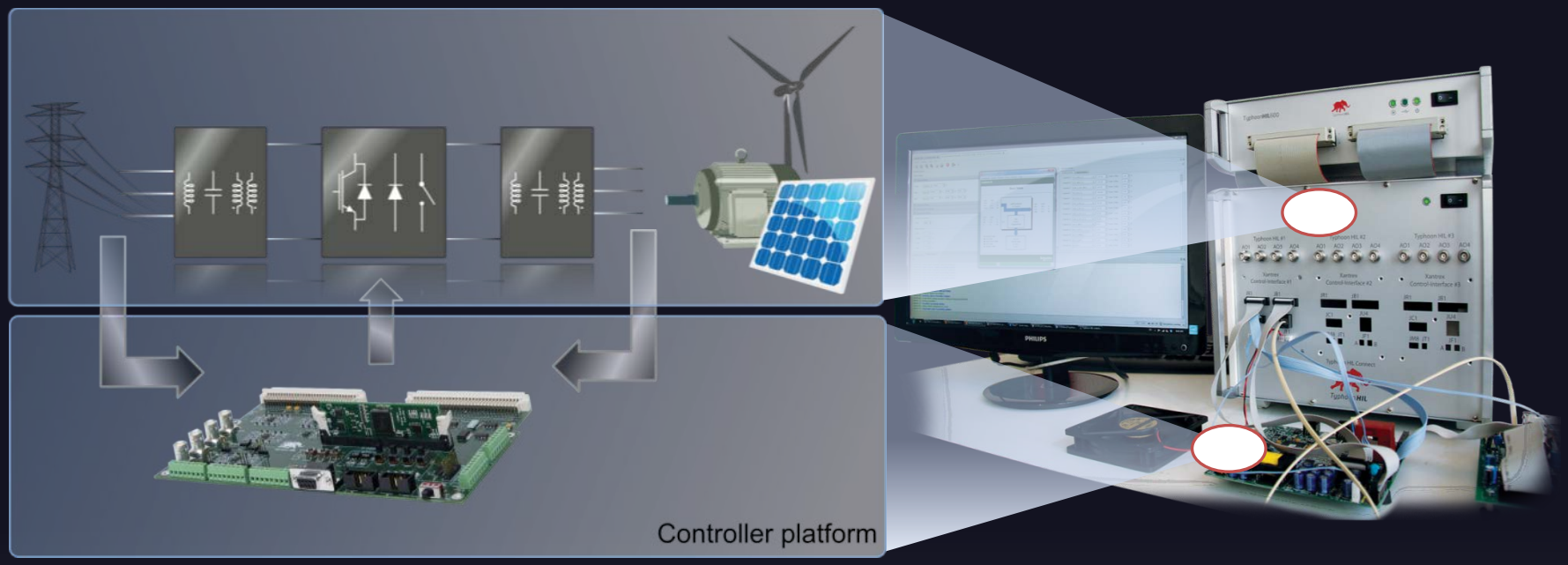
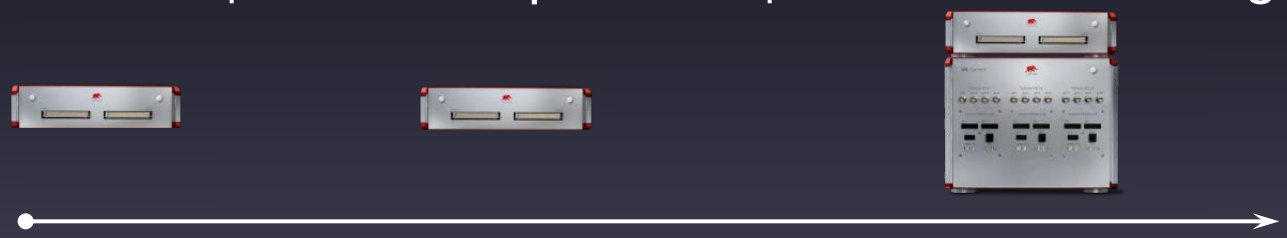



R&D | Development | Converter Testing |



Power electronics product lifecycle

# Ultra-high fidelity real-time simulation combined with ease of use is revolutionizing smart inverter testing

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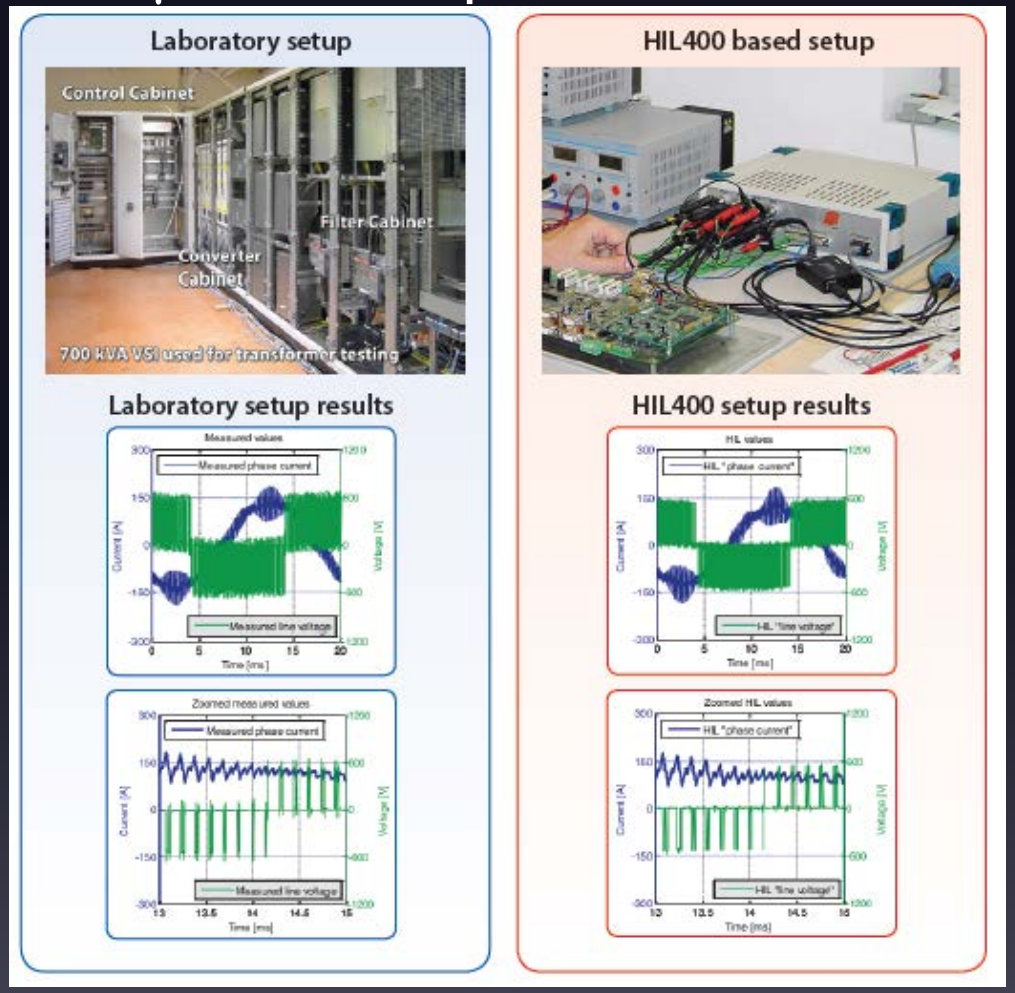
**Ultra-high fidelity**: 20 ns PWM sampling, 0.5-1μs time step



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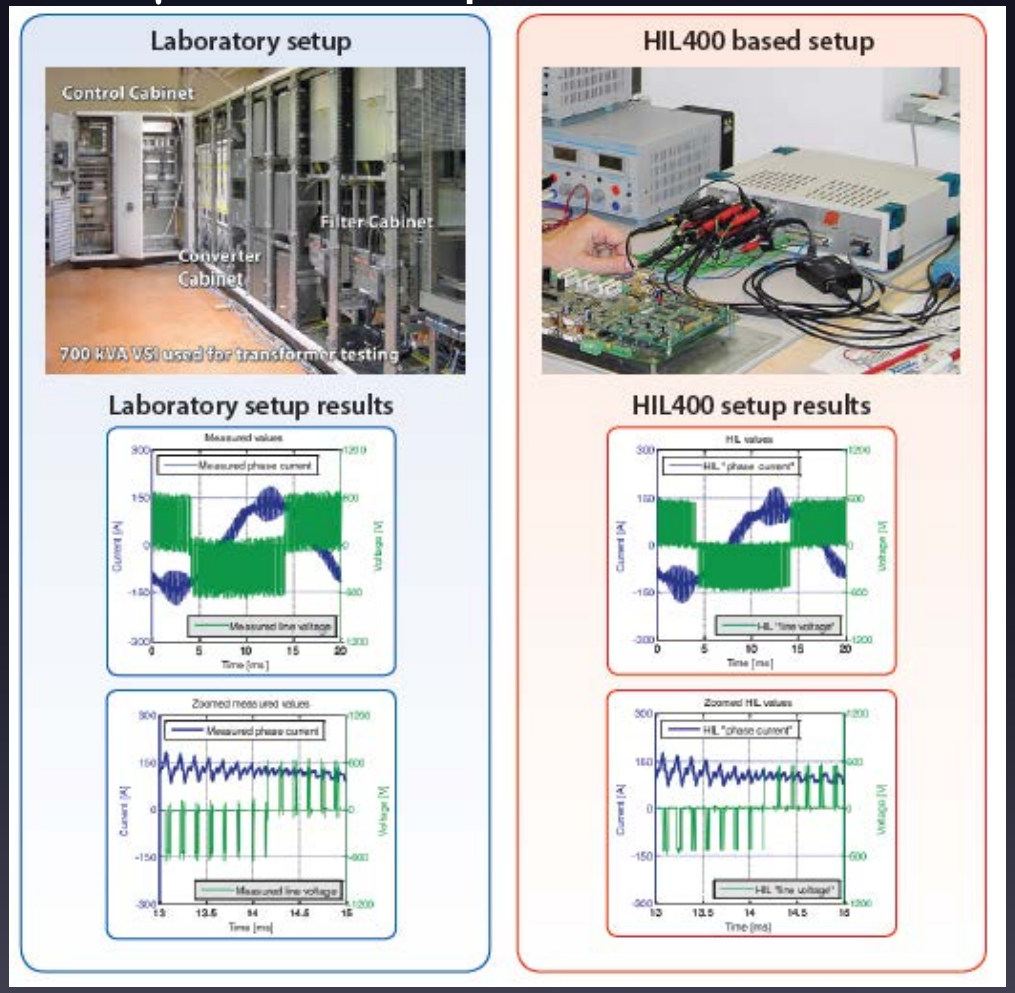
**Ultra-high fidelity**: 20 ns PWM sampling, 0.5-1μs time step

Easy to use

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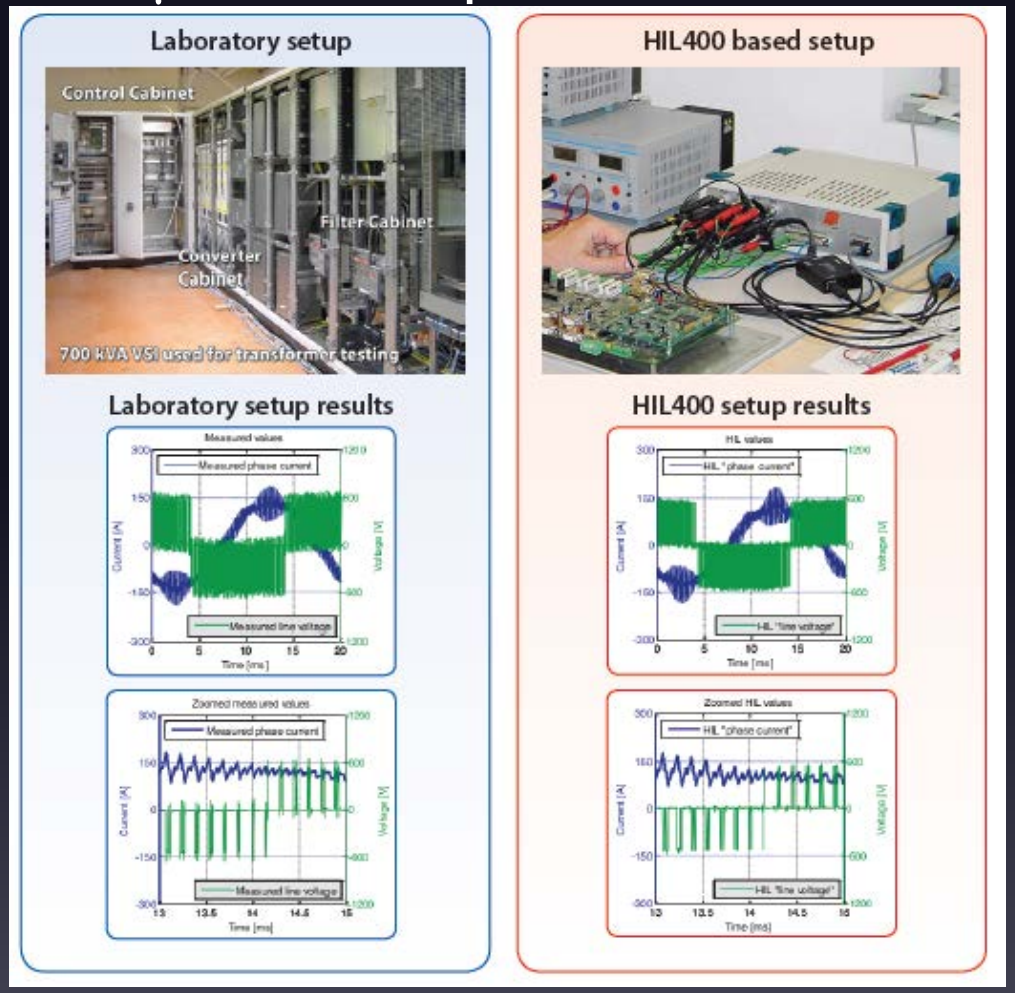
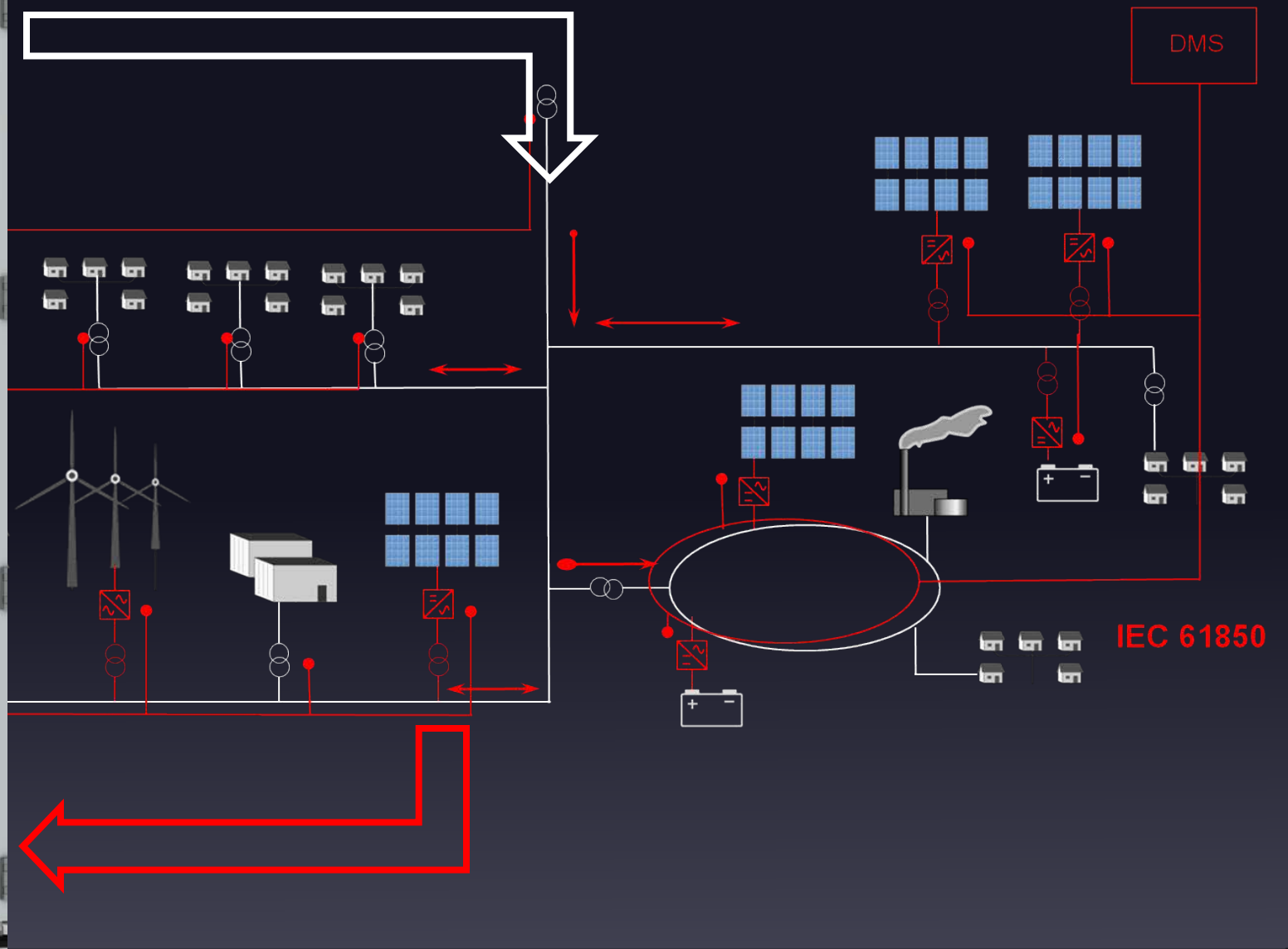


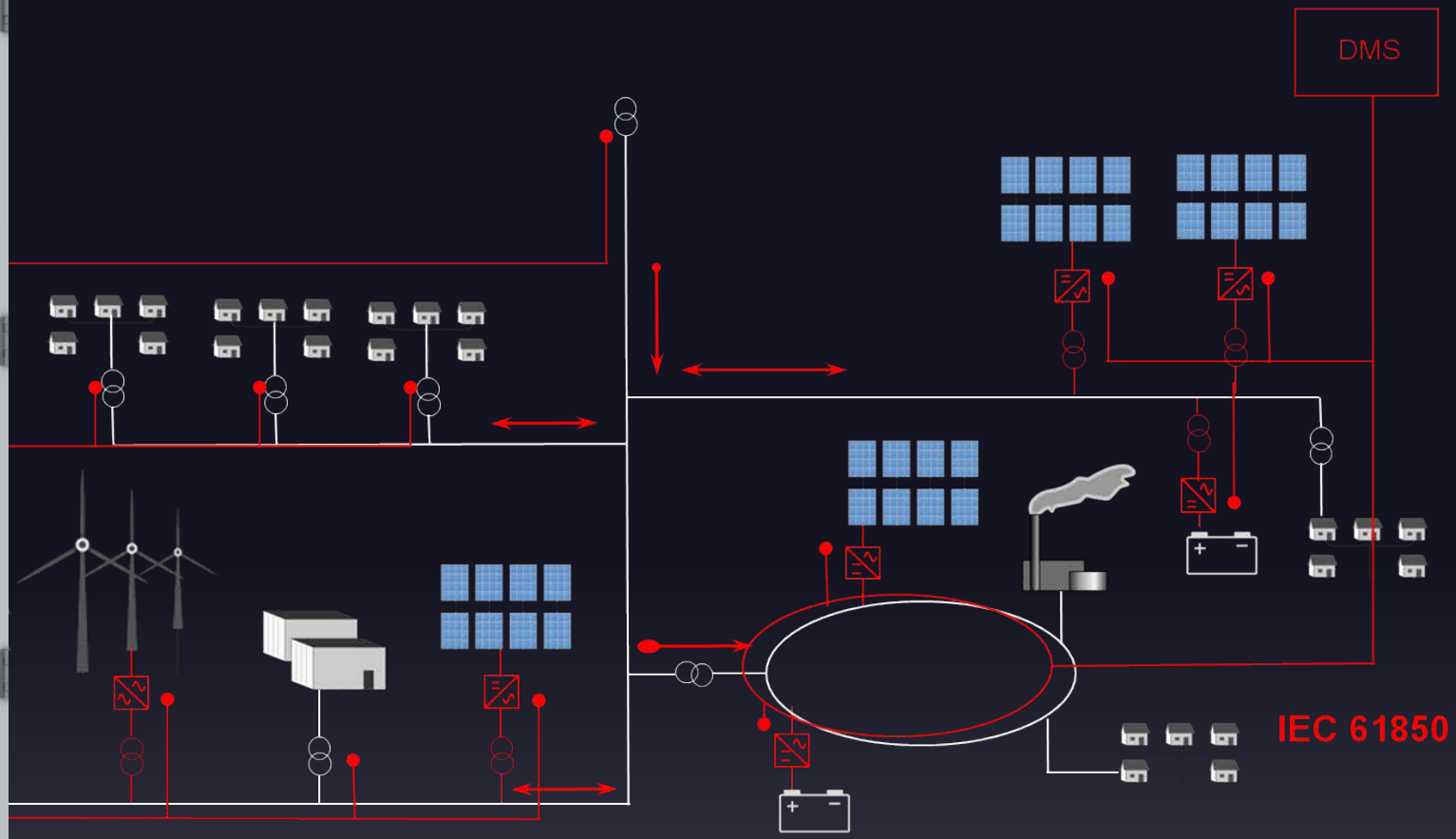

Easy to use

Plug and play interface to industrial controllers (customized)

# The new way of **TESTING** **Complete Systems.**
# The **Controller Hardware-in-the-Loop** way.

# **20ns** sampling time, and **500ns** simulation time step enables finding problems on µs to hours timescales

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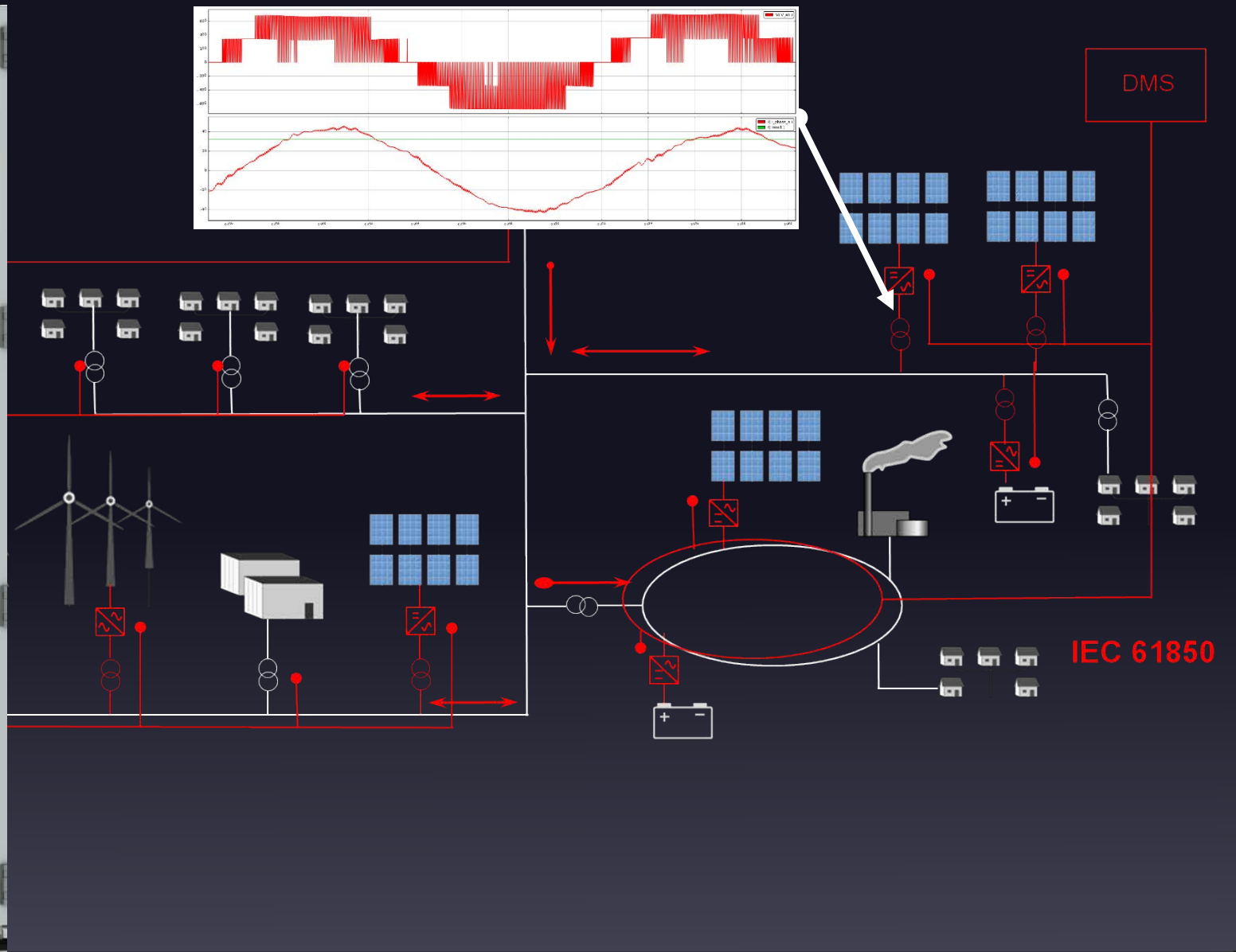

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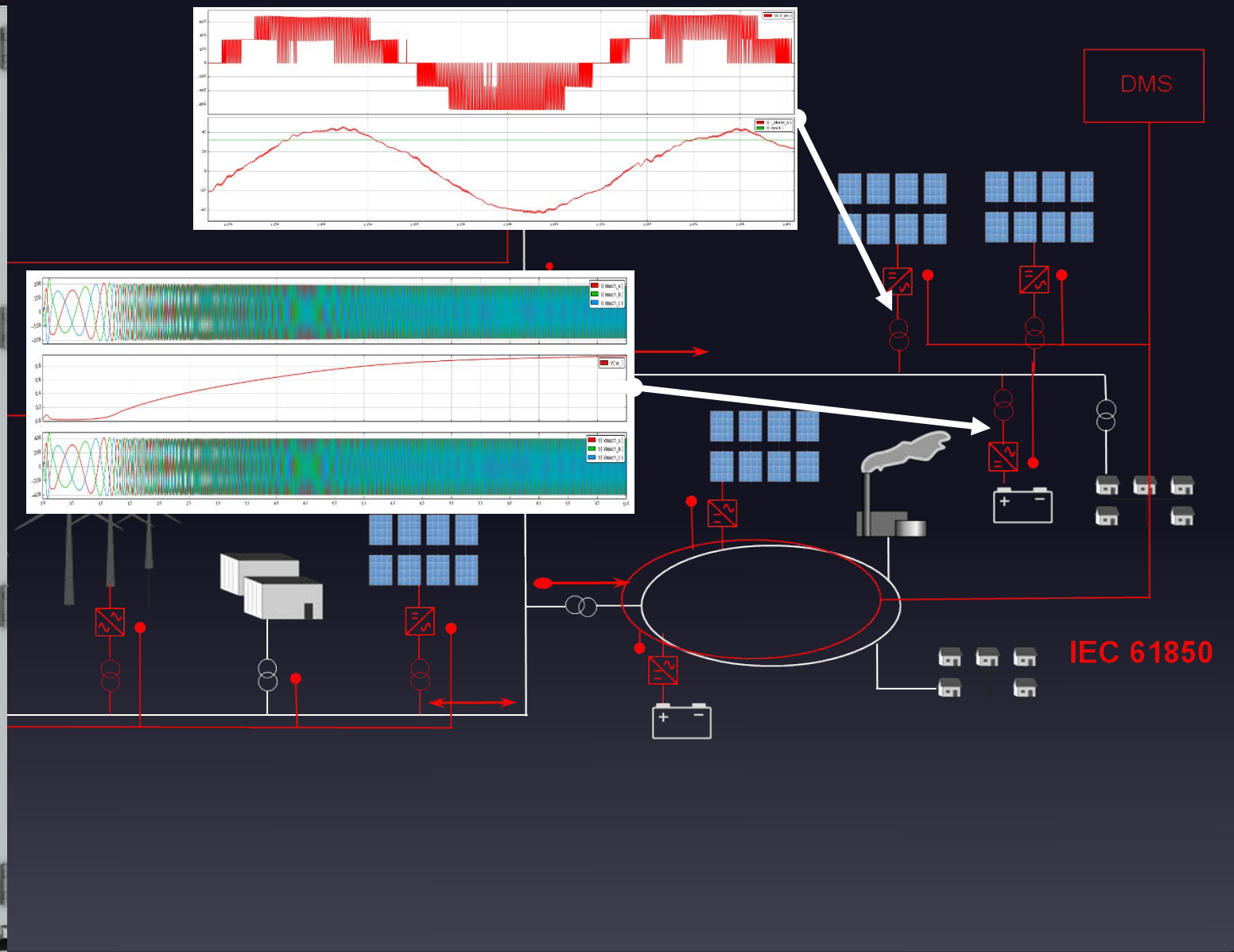
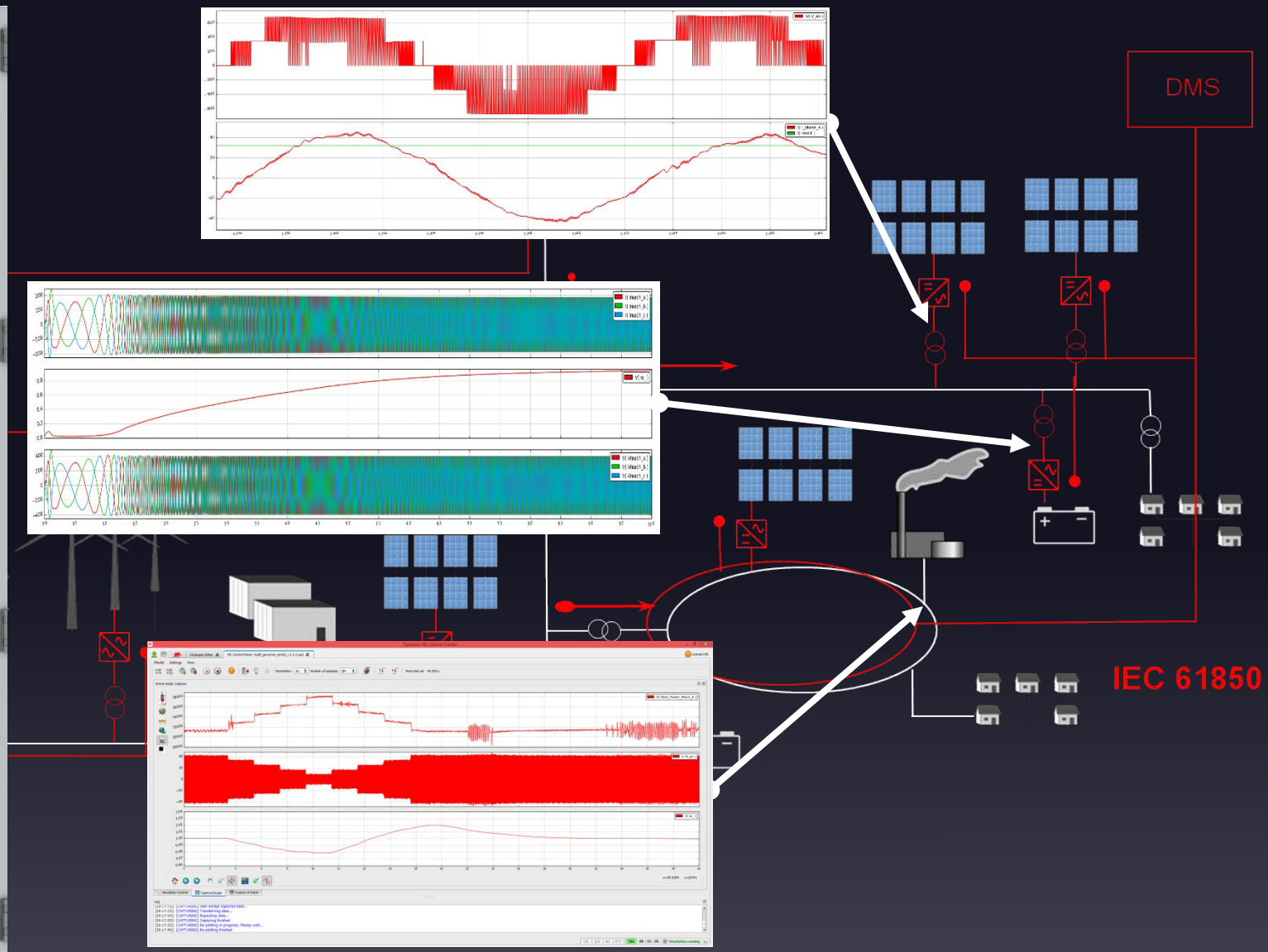
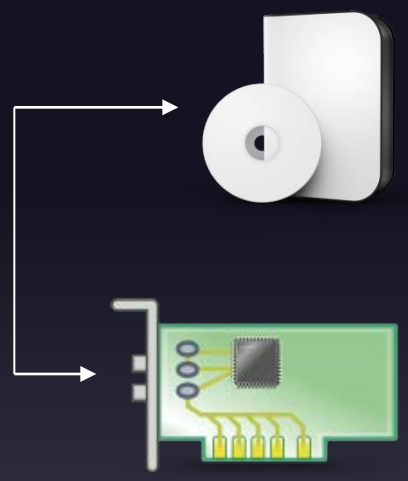


# **20ns** sampling time, and **500ns** simulation time step enables finding problems on µs to hours timescales

# Ultra-high fidelity via vertically integrated cHIL solution



Software

Hardware

PLUG and PLAY

HIL API

HIL Software

HIL Hardware

HIL Interface

OEM Control System

Typhoon HIL Solution

**cHIL** Advantage:

orders of magnitude better test coverage

orders of magnitude lower cost of testing

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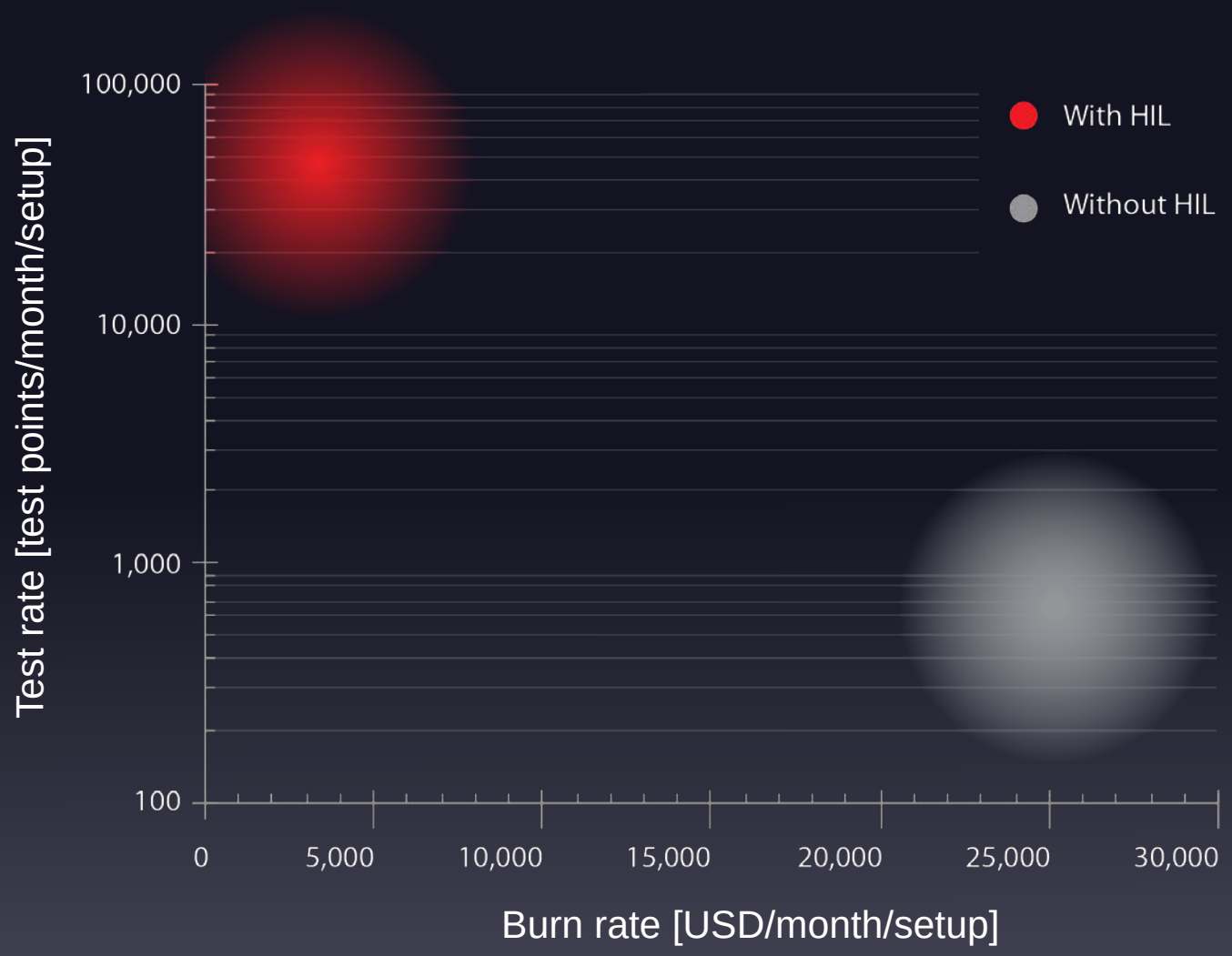

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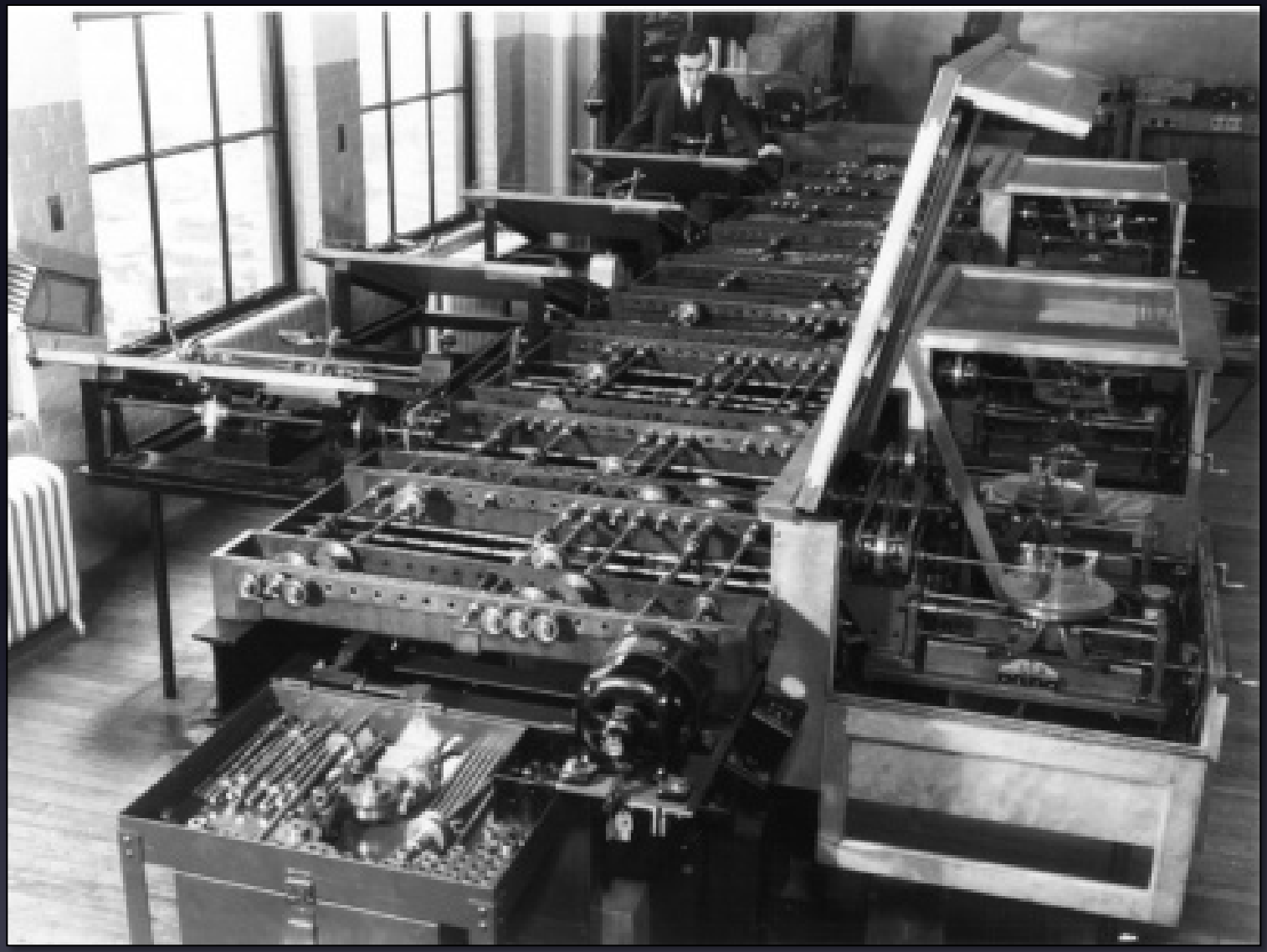
- Improving software quality is a key topic for all industries.  Power systems included.

# Differential analyzer, Vannevar Bush, MIT 1927



# Test relentlesly.

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